RADIO

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THE WORLDWIDE TECHNICAL AUTHORITY • OF AMATEUR • SHORT WAVE AND EXPERIMENTAL RADIO •

This Month:

A 9-10 Meter Mobile Phone Transmitter

Barrage Directional Antenna Arrays

An Acorn-Tube 56-Mc. Superheterodyne

"Mighty Mite"--A 20-Watt All-Band Phone

"*Yarnette*" of the Month

● W8NQD and myself had just put the finishing touches on our new one-quarter kw. rig which we hoped would knock the Aussie's headsets for a loop of secondhand boomerangs when the following events occured.

We had just tightened up the last bolts, inserted the T55's and were about to flick the switch that would fire up the rig when I happened to glance in the general direction of the pile of junk we fondly call a power supply.

Holy smokes and little fish hooks! If there ain't the prettiest black and white pole kitty as ever I laid my two eyes on, all curled up between the 866's to keep her nose warm.

You probably wonder why I so consistently refer to our visitor as "she". We later came to the conclusion that no male of any critter could wreak as much havoc in so short a time as this pretty lady did.

To make a short story as long as possible, the hide off'n one of these despised but pretty creatures is worth its weight in T20's, providing it is separated from its wearer—a task requiring tact, a gas mask, a suit of old clothes and a vacant lot miles from the nearest outpost of civilization.

Further examination of our intended victim showed among other things that she was dead to the world, her paw resting securely on the plate lead to one of the 866's, while her posterior parts were conveniently grounded to the metal chassis. What a position for immediate eviction of her soul from its worldly castle!

A flip of the switch at my elbow and two thousand volts of angry, buzzing a.c. would tear through her vitals, reducing her to a smoldering crisp. True, I did feel somewhat like a cold-blooded killer, but the thought of that glistening T20 eased the pressure on my conscience, and with a prayer on my lips for the poor creature's soul, I did the dastardly deed.

With an ear-splitting shriek as if from a lost soul in torment our intended victim bounded from her improvised death chair, tail high and laying down an overwhelming barrage of nauseating vapor, comparable to nothing since the Great War.

For fully two minutes she hurled her effective offensive drive, while we, the enemy, shrieking oaths, choking and blinded, overwhelmed by this sudden and unexpected display of power, retreated in rank disorder, attempting in our haste to back bodily through a solid eight-inch cement wall. Failing in this, we climbed through a conveniently located window, not hesitating to open same, while our opponent, dignified, and unhurried, head high, retired from the field of battle through the front door.

And now, dear readers, if on forty meters

As the spirit moves, we present in this column from time to time a bit of gossip about RADIO, its affiliated publications, and those who produce and distribute them—"From the private life of RADIO".

Since our conscience bothers us, we inaugurate this column with an admission of guilt, that we swiped this idea lock, stock, and barrel from *Time*, and only hope that we can make it half as interesting as they do.

Now to the most important news of the month:

Never happy in its inability to reach its eastern readers (who constitute the great majority) at what they consider as "on time", RADIO has completed arrangements for the October and succeeding issues to be printed and shipped from the plant of a large eastern publication printer, some 3000 miles from its offices.

A record?

So far as we know this constitutes some sort of a record. Does anyone know of another periodical whose editorial and business offices are so widely separated from the production plant?

More details in the next issue; we're short on space this month.

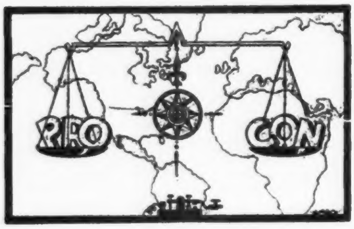
A GENTLE REMINDER

That "Radio" publishes no August or September issues.

●

The next issue is the October issue, out about September 25th.

some evening you hear a raspy r.a.c. note chirping merrily along and signing W8PMD, and if in the opinion of yourself and others the keying smells, remember, so does the operator.



The Open Forum

INFERNAL DIT-DAHS

Cleveland Heights, Ohio.

Sirs:

While reading "The Open Forum" for June, I happened to run across a letter written by A. M. Croft. It was the usual, flimsy, no-code argument and it didn't bother me much until I came across the words "infernal dit-dahs". Bah! The very idea of insulting our code in that manner.

Mr. Croft has never been on c.w., let alone the air, so how is he qualified to denounce it? When you have been on c.w. and *know* it, there is no "infernal dit-dahs" about it. After a while the boys on c.w. seem like they are literally "talking" to you. Some of them have sweet filtered feminine voices, some have raucous TNT coughs, some have a T8x drone, some stutter and others talk smoothly, even sometimes their voices crack, (QRH).

This and hundreds of other things make c.w. what it is today.

There are many foreign characteristics too, the "frequencyless" splutter of Cubans, the weak peep of the Japanese, etc., and might I add the 25-cycle trill of some of the boys in Ontario.

No, Mr. Croft, no "infernal dit-dahs" to those who know them any more than the fone boys are "infernal mush-mouths" to the boys who do not know them!

LLOYD W. FROHRING, W8PMJ

July • 1938 No. 231

RADIO

The publishers assume no responsibility for statements made herein by contributors and correspondents, nor does publication indicate approval thereof.

In this issue "Radio" presents:

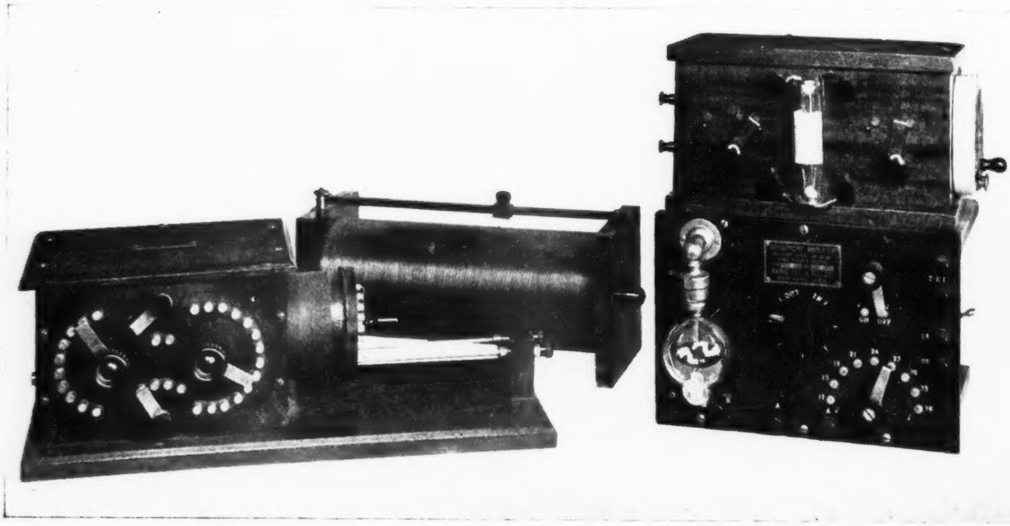
ARTICLES

MISCELLANEOUS FEATURES

DEPARTMENTS

THE WORLDWIDE TECHNICAL AUTHORITY OF AMATEUR, SHORTWAVE, AND EXPERIMENTAL RADIO

Looking Back



Do you oldsters remember when you would have given your eye teeth for the equipment pictured above? In the background is one of the Adams-Morgan company's old single slide tuners. To the left can be seen the Nichols Electric company's "navy" loose coupler, while at the right is a genuine audiotron RJ4 detector, a relic of pre-war days. It is perched on top of a P3 DeForest one-stage audio amplifier (remember them?). McMurdo Silver sent in the photo.

THE DX "BAND HOPPER"

The somewhat strange-looking transmitter shown in the accompanying photographs is a quick-band-change affair designed primarily for the medium-low power c.w. man interested in dx, which naturally means 40, 20, and 10 meters. If either a three-band antenna or three separate antennas are available, it is possible to go from one band to another by merely throwing two switches and "redipping" one tuning condenser. While the last stage is not heavily enough excited for plate modulation at full input, the unit can be used as an exciter for either a 500-watt plate-modulated amplifier or a kilowatt c.w. amplifier. The time required for band-changing such a transmitter will be greatly reduced by the incorporation of the band-switching exciter.

However, we will assume in the following discussion that the rig is to be utilized as a 100-watt c.w. transmitter on 40, 20, and 10 meters.

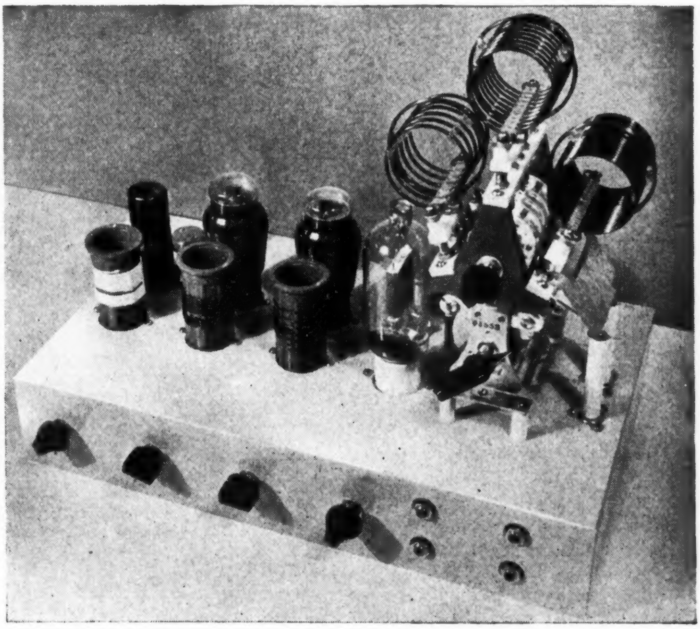
The unit consists essentially of a dynapush exciter* coupled inductively by means of untuned pick-up coils to a TZ-40 neutralized amplifier. While this system of coupling does not permit utilization of the maximum amount of drive available from the dynapush section, sufficient drive is obtained on all bands to drive the TZ-40 to from 20 to 30 ma. of grid current. This amount of excitation was found sufficient for operation of the TZ-40 at good efficiency. And it does greatly simplify the circuit over that required for bandswitching were a tuned grid circuit used for the TZ-40.

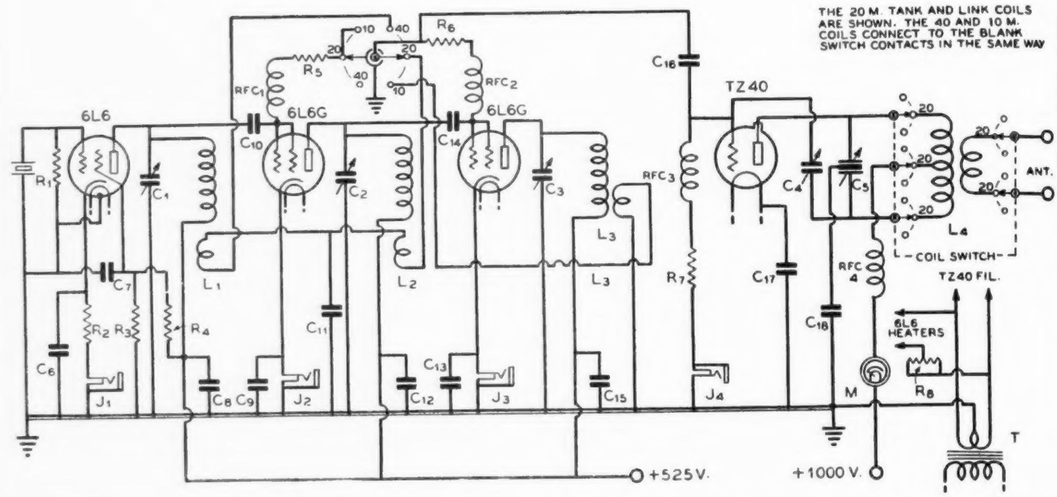
No practical difference in operation was observed between a T-40 and a TZ-40 with the value of grid leak specified in the diagram. Hence a TZ-40 was used, inasmuch as it permits oscillator keying without the necessity for fixed bias on the final amplifier stage. The resting current of a TZ-40 at 1000 plate volts is low enough at zero bias that the plate dissipation is not exceeded when there is no excitation. Possibly slightly higher efficiency could be obtained by use of a T-40 and a higher value of grid leak, but it is difficult to get enough voltage swing across the untuned pick-up coils for proper operation with a 7500- or 10,000-ohm leak.

With the TZ-40 and 20- to 30-ma. grid current through the 2000-ohm leak, it is possible to obtain from 85 to 100 watts output at an input of 125 to 135 ma. at 1000 to 1050 volts.

*February, 1938, RADIO, page 19.

The Dx Man's Transmitter—for use on 10-, 20-, and 40-Meter C.W. Bands.





R_1—50,000-ohm 1-watt carbon
R_2—300 ohms, 10 watts
R_3—20,000 ohms, 10 watts
R_4—15,000 ohms, 10 watts
R_5—10,000 ohms, 10 watts
R_6—7500 ohms, 10 watts
R_7—2000 ohms, 10 watts
R_8—1-ohm c.t. resistor, 10 watts, connected to give ¼ ohm
RFC_{1-3}—2.5-mh. midget r.f. chokes
RFC_4—2.5-mh. r.f. choke, 250 ma.
C_1—50-μμfd. double spaced midget (2000-volt spacing)
C_2—50-μμfd. double spaced midget
C_3—35-μμfd. double spaced midget
C_4—5-μμfd. double spaced midget
C_5—100-μμfd. per section, 2000-volt spacing
C_6—.006-μfd. mica (1000 v.)
C_7—.006-μfd. midget mica (500 v.)
C_8—.006-μfd. mica
C_9—.006-μfd. mica
C_{10}—.0001-μfd. mica
C_{11}—.006-μfd. midget mica
C_{12}—.006-μfd. mica
C_{13}—.006-μfd. mica
C_{14}—.006-μfd. mica
C_{15}—.006-μfd. mica
C_{16}—.006-μfd. midget mica
C_{17}—.006-μfd. midget mica
C_{18}—.006-μfd. mica
L_1, L_2, L_3—See coil table
L_4—Turret type coil switching assembly
M—0-200 or 0-250 ma. d.c.
T—7.5 volts at 6 amps. (need not be mounted on same chassis if short, heavy leads are used)

Power Supplies

Both power supplies, the 500- to 550-volt one for the 6L6's and the 1000-volt one for the TZ-40, require no special mention other than the fact that they should possess good regulation, which indicates mercury vapor rectifiers and choke-input filter systems. The drain on the low voltage supply varies considerably depending upon whether one, two, or all three of the 6L6's are being used, and unless the supply has good regulation, the voltage will rise to excessive values when only one 6L6 is being used. The supply may consist of a 700-volt transformer, 83 rectifier, and single section choke-input filter with 4 to 8 μfd. of 600-volt oil-filled condenser, the transformer and choke being designed to handle 250 ma. The high voltage supply may consist of a 1150- to 1250-volt transformer, 866JR rectifiers, swinging input choke, and 2 μfd. of 1000-volt oil-filled condenser. The transformer and choke should be capable of handling 150 ma., and a bleeder of from 75,000 to 100,000 ohms (25 watts) should be used to keep the voltage from soaring when the load is removed, endangering the 1000-volt filter condenser.

The final tank assembly utilizes one of the new turret type band switching assemblies. First considered was the use of three separate tanks, thus doing away with the necessity for retuning the final amplifier plate tank when changing bands, but the additional cost and complications resulted in the incorporation of the arrangement illustrated. It takes only a second to retune the tank condenser when changing bands, and this seemed preferable to buying a couple of extra tank condensers.

Considerable trouble was experienced in getting the plate current to dip as it should on 10 meters when the tank was unloaded. Then it was discovered that the "floating" 40-meter coil was hotter than the 10-meter one; evidently it was resonating at 10 meters. Removing the 40-meter coil permitted the 10-meter coil to "dip" nearly as well as the 20-meter one, proving that the 40-meter coil was stealing power from the 10-meter coil, resulting in high minimum plate current.

To remedy this difficulty, two plates of thin

COIL DATA

40-METER COIL

14 turns no. 18 d.c.c. close wound. Pickup coil, 8 turns no. 18 d.c.c. spaced 1/8 in. from cold end, polarity as in wiring diagram.

20-METER COIL

6 turns no. 18 enam. spaced to 5/8 in. Pickup coil, 5 turns no. 18 enam. spaced half diameter of wire, spaced 1/3 in. from cold end, polarity as in wiring diagram.

10-METER COIL

4 turns no. 18 enam. spaced to 1¼ in. Pickup coil, 2⅓ turns interwound at cold end of coil, polarity as in diagram.

All coils wound on standard 1½-in. dia. forms, turns on space wound coils held in place with Duco cement. Turns and dimensions are quite critical, and may require pruning if physical layout much different from that illustrated is used.

galvanized iron were cut out with tin snips and soldered directly across the 40-meter coil jacks as shown in the photograph, so arranged that about 2 square inches of overlap existed. These were bent in and out till the coil resonated at about 14 meters, effectively detuning the coil sufficiently that very little power is absorbed. Too much capacity across the coil will cause it to resonate in the vicinity of 20 meters, and trouble will then be experienced with high minimum plate current on 20 meters. Just enough capacity should be used across the 40-meter coil to reduce the 10-meter energy picked up to a very low value, as evidenced by lack of "pencil sparks" on the ends of the 40-meter coil with the transmitter working on 10 meters; more capacity will result in difficulties with coupling between coils on 20 meters. It seems surprising that the floating 40-meter coil can resonate at 10 meters, but a space wound coil has a much higher natural frequency than one would expect. Because of the low ratio of capacity to inductance, a couple of micromikes of shunt capacity will produce a great change in the resonant frequency.

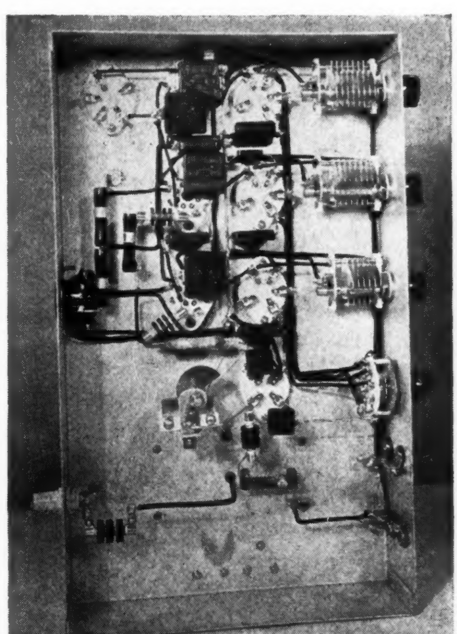
The isolantite bandswitch for the dynapush portion is of the two-pole type. This enables one to use a single-gang switch for switching both the d.c. bias returns on the 6L6-G's and the r.f. excitation to the TZ-40.

Coils

The dynapush coils are all wound on 1½-inch forms as indicated in the coil table. It is very important that the coils L_1 and L_2 be wound as specified, with polarity as shown in the wiring diagram. If this is not done, there will be a detuning effect and it will be necessary to touch up the condensers C_1 and C_2 when changing bands. If wound as described, it will not be necessary to touch the condensers when changing bands with the same crystal, or a crystal in the same part of the 40-meter band. When going from one edge of the band to the other, however, it will be found desirable to retune the 6L6 tuning condensers, though not absolutely necessary.

There is no need to worry about detuning effect on the 10-meter coil, because it either feeds the TZ-40 or doesn't work at all. It is not feeding another 6L6-G part of the time as are the first two tanks. Hence it is not necessary to avoid capacitive coupling between wind-

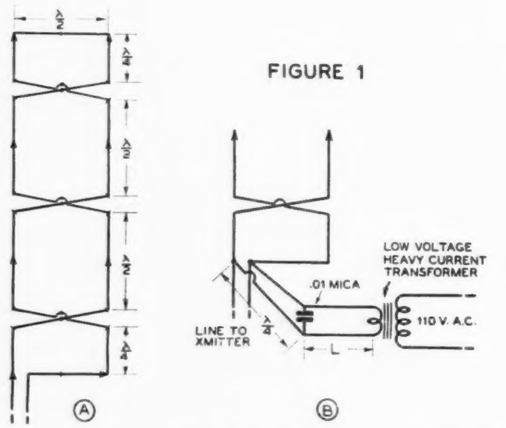
[*Continued on Page 88*]



Underchassis view of the band hopper. Note layout of the various components.

THE BARRAGE ANTENNA

By RAY L. DAWLEY,* W6DHG



(A) shows current distribution in Sterba vertically-polarized curtain. Arrows indicate direction of current flow. (B) shows method of feeding heating current to array. Length L should be kept small.

In recent years radio amateurs have become more and more aware of the wide usefulness of directional arrays made up of phased elements. There was a time when many amateurs were of the opinion that the only way in which to obtain really good gain in an antenna system was to use either a rhombic or a long "V" antenna. Then, four or five years ago, several of the 20-meter phones installed arrays consisting of a number of co-linear phased half-wave elements. The results obtained were good, and so it was left at about that status. But a short while after this E. J. Sterba, of the Bell Telephone Laboratories, published a paper discussing a type of antenna he had developed for use by A. T. & T. in its transoceanic telephone circuits. Adaptations of this type of antenna have been found to give the greatest gain considering the amount of distance they take for their construction of any antenna commonly used. This article will deal with these adaptations.

Close-Spacing, Out-of-Phase vs. Wide Spacing, In-Phase

There are two fundamentally different methods of operating co-phased dipole elements in directional antenna systems. The first, employing close spacing with the dipoles out-of-phase, has received by far the greatest amount of publicity in the last year and a half or so, due primarily to an article, a classic in its field, by G. H. Brown that appeared in the January, 1937, I.R.E. *Proceedings*. The flat-top beam, antenna-director and antenna-director-reflector systems are among the best known of the close-spaced arrays. These systems have considerable merit, especially by the fact that reasonable gain may be obtained with a comparatively small amount of wire and in a small amount of space. But all these varieties of close-spaced arrays have the common disadvantage that their radiation resistance is quite high, thus making them somewhat diffcult to feed properly, causing high copper and insulation losses, and making them quite selective as to frequency of operation.

The second method of operation of phased dipoles is with wide spacing (almost always with ½-wave spacing or very close to it) and with the two wires operating in-phase. These types of antennas have a comparatively high radiation resistance, hence are easy to feed properly and efficiently, have low inherent losses and are easily capable of operating over an entire amateur band with almost no loss in efficiency.

Of course, close-spaced arrays do have the undeniable advantage of compactness. And since there has been a great deal of interest shown of late among the phone men in rotatable arrays, close-spaced systems have received much publicity as their compactness and easy rotatability make them well suited to the job. But a number of the phone men, after having installed fancy little rotatable gadgets and having found that it doesn't make a whole lot of difference in which direction said rotatable gadgets are pointed after they have been installed, are beginning to think that the c.w. men were right in leaning toward *high*-gain fixed beams oriented in a certain desired direction. Of course, a large number of us do not

*Technical Editor, RADIO.

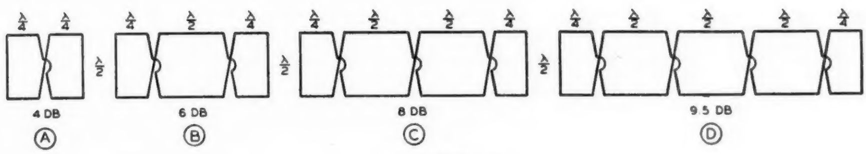


FIGURE 2

Electrical layout of four simpler barrage antenna arrays shown with their approximate gain in decibels.

have sufficient room on our assigned plot of ground to install any very extensive array or system of arrays; we are almost necessarily limited to some type of a small and compact rotatable array, or to small, medium-gain fixed beams.

The Sterba Curtain

The original Sterba curtain is the basis of the design of the beams to be shown in this article. The arrays as used by A.T.& T. consist of a large bank of *vertically*-polarized elements as shown in A of figure 1. As can be seen from the diagram, the elements are continuous and consist of one long piece of wire. This is an advantage where the antennas are used in locations where sleet or ice has a tendency to form on the wires in winter, since a low-frequency alternating current can be passed through the wire to heat it enough that ice will not form. The method of feeding the heating current to the wires is shown in B of figure 1. Although this will be of interest to but few amateurs, some in unusually cold climates may be able to make use of the idea. A low-voltage heavy-current filament transformer may be used to supply the heating current.

By simply turning this curtain on its side, and changing the feed position if desired, we have the type of *horizontally*-polarized system to be described in this article. These systems are shown in the "RADIO" HANDBOOK and the ANTENNA HANDBOOK; this article will deal with adaptations of the systems and with methods of feed and installation.

The basic types of the arrays are shown in figure 2. In each case it can be seen that the arrays consist of a $\frac{1}{4}$-wave long section at each end with either one, two or three double half-wave sections in between them, or, as in the most simple example, with only the two end sections connected together. The approximate gains of the different arrays, as compared to a $\frac{1}{2}$-wave doublet, are shown along with them.

The simplest of the arrays is interesting in that it is only $\frac{1}{2}$-wave long and $\frac{1}{2}$-wave high and yet it gives a gain of approximately 4 db over a dipole in this small space. Also, it is quite easy to feed as its radiation resistance is somewhat higher than that of a half-wave doublet. It can be fed by means of a shorted $\frac{1}{4}$-wave stub at the center, or it can be fed by transmission line of a characteristic impedance of about 125 ohms by breaking one of the end sections at the bend as shown in figure 3D. Either method of feed will be quite satisfactory for this array.

Methods of Feed

As was stated earlier in the article, these beams are quite easy to feed due to their high radiation resistance. And, due to their high radiation resistance, their effective Q is small. This allows them to be used, regardless of the

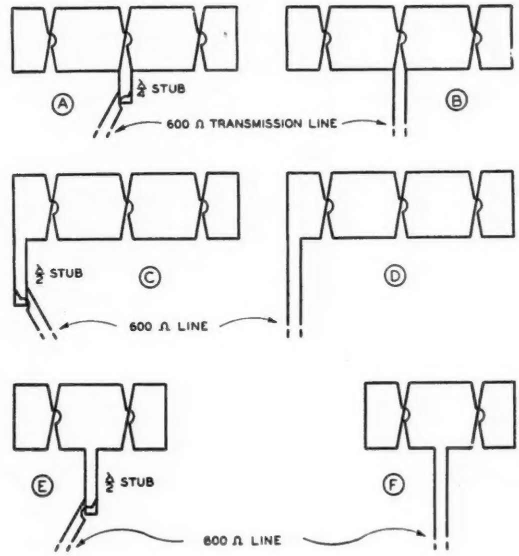


FIGURE 3

Permissible methods of feed.

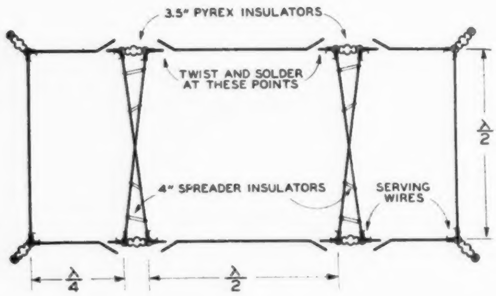


FIGURE 4

Practical method of construction of barrage arrays. See text for discussion.

feed system, over a comparatively large frequency range; thus all may be operated over the 14-Mc. band with little change, and very little change will be experienced when operating over the entire 28-Mc. band.

The permissible feed arrangements are shown in figure 3.

Probably the best method of feeding an array of this type when it is to have an even number of center ½-wave elements (zero or two as in figure 2 A and C) and is to be symmetrical, is to feed it as in figure 3A. However, very little difference will be noted between the different feed methods; all those shown in figure 3 will be found quite suitable. The fact that these arrays consist of a continuous piece of wire assists in maintaining even current distribution even though the array may be fed at one end. Feeding systems are further discussed in the section "Tuning Up."

Installation

As is the case with all multi-element antenna arrays, there is quite a difference in the approach to the problem between the pencil-and-paper, and the wire-and-insulator stages of the construction. However, in the installation and testing of quite a number of these arrays on different bands, a number of different ways in which *not* to make the installation have been learned. And, in the course of time, a number of short cuts to the proper way in which to put them up have been discovered.

The first thing to do in installing an antenna of this type is to determine what the ½-wave and ¼-wave lengths are going to be at your operating frequency. And, it must be emphasized, the conventional lengths given for operation at these frequencies will not hold; conventional tables take into consideration the end effects present in ordinary antennas. As there are no ends to the wires in these antennas (see diagram) there will be no end effects. Design tables have been given in the RADIO ANTENNA HANDBOOK, or the correct dimensions may be calculated by dividing the operating frequency in megacycles into 492, the answer to be in feet.

Then, upon looking at the diagrams as given in figure 2, figure how many ½-wave sections of wire will be needed. All the antennas will require two pieces of wire a full wave long (for the two end sections) and two or more additional half-wave pieces. The ½-wave phasing sections of the antennas are made up individually and later placed in the array, so figure on two ½-wave pieces of wire for each of these sections. For example, take the array given in figure 2B. There will be two full-wave pieces of wire required for the end sections; then, since there are two ½-wave phasing sections, four ½-wave pieces of wire will be required for these, and two additional ½-wave pieces will be required for the other radiating sections.

The construction of this array, as an example, has been diagrammed in figure 4. Each of the pieces of wire that is to go to make up one of the ½-wave phasing sections is made six inches longer than its theoretical length to allow three inches at each end for splicing. All other pieces are made the theoretical length. The ½-wave phasing sections are made up first and each one consists of two ½-wave pieces of wire, two 3½" Pyrex antenna insulators (or other suitable strain insulators of about the same length) and enough 4" porcelain spreaders to allow them to be spaced about every five feet in the phasing section. Thus, for a 20-meter array where these sections would be about 34 feet long, six spreaders would be required and the spacing between them would be about 4'10".

The ends of the wires are threaded through the two end strain insulators with about three inches of free end extending through. Then the so-called "serving wires" are placed around the insulators to hold them in place on the wires. These serving wires should be scraped so that they may be soldered in place when the array is assembled. Then the spreaders are placed along the wires and held in place by serving wires in the conventional manner.

The two end sections should then be made up from the two full-wave pieces of wire. Strain insulators are placed ¼-wave in from each end of these two wires and held in place by serving

[*Continued on Page 94*]

Versatile Portable RECEIVER

By JOHN BOLMARCICH, JR.,* W3AXK

After having operated portable mobile on the five-meter band for the past two years it was decided to give ten-meter portable mobile a try. The incentive for ten-meter operation was further increased by several descriptions of ten-meter mobile crystal-controlled transmitters which have appeared in recent issues of RADIO. Outstanding among these, in the writer's interest, was the one described by George M. Grening in the April, 1937, issue of RADIO. A variation upon this transmitter was constructed and the results obtained were excellent. But the problem of an efficient and versatile ten-meter receiver was not so easily solved.

The Receivers

The first receiver that was tried was a superregenerative job. Although the sensitivity of this receiver was fairly good, the selectivity was very poor for operation in the crowded ten-meter band. The obvious solution was then to use a superheterodyne. And yet, to use a superheterodyne without some kind of an efficient noise silencer is almost out of the question for mobile work due to automobile ignition interference.

The answer, in my particular case, was to use a superheterodyne when parked upon the favorite hilltop and to use a superregenerative while in motion. It at first appeared that two receivers would be needed, but after thinking the problem over it was decided that one receiver could probably be made to act both as superhet and superregenerator.

The receiver to be described is the result of considerable thought and experimentation along this line.

Choice of Intermediate Frequency

It is well known that to obtain good image rejection in a ten-meter superhet the intermediate frequency should be made as high as possible. But a compromise must be reached since as the i.f. is increased, the gain and selectivity in the i.f. amplifier decreases proportionately. Hence, the best solution seems to be to use a double-i.f. triple-detection superheterodyne. It would at first appear, especially for mobile work, that the cost and complications of such a receiver would be prohibitive. But such is not the case; the complete double i.f. channel, the audio stages and the power supply can be bought for somewhere between five and ten dollars. And the form in which it was purchased was that of a slightly used auto set.

The I.F. and Audio Channel

The market is flooded with auto radios of a couple of years back which have been traded in upon newer models. Of course, when you go out to buy one it is surprising how "unflooded" the market can suddenly become, but it will usually be possible to convince some dealer that he has too many turn-in's on hand. By doing some shopping around I was able to get a six-tube superhet of well-known make for five dollars. The only thing wrong with the set was a torn speaker cone. This was inexpensively repaired, and when the set was re-aligned, it performed as well as new.

The receiver employed a 44 r.f. stage, a 77 mixer, a 44 i.f. stage, a 75 second detector, a.v.c. and first audio and a 42 in the output. An 84 was used as rectifier in the power supply. Although the receiver is fairly old (1934 model), it compares favorably with the newer receivers. The basic circuits used in auto radios have changed little in the past three or four years except for the addition of push-button tuning in some of the 1938 sets. This, of course, would be a decided disadvantage in a receiver to be used as described.

By making a few minor changes, I now have a good ten-meter superheterodyne, a ten-meter superregenerator, a five-meter superregenerator,

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a 160-meter receiver, a marine receiver, and it is still a good broadcast set. And, if desired, the receiver may also be used as a superheterodyne on five by employing plug-in coils in the mixer stage.

Constructional Details

The first thing to do in the revision is to remove the vibrator supply from the receiver cabinet. The supply is then rebuilt into a small box and permanently installed in the car. When portable operation is desired, this power supply (which, incidentally, is capable of an output of 250 volts at a drain of 50 ma.) is connected to the receiver by means of a power cable. The supply serves double duty in my particular case by also furnishing plate power to the modulator stage of the mobile transmitter.

Through the separation of the power supply from the receiver, it is possible also to use the unit in the station and to operate it from a conventional a.c.-operated power supply. Its versatility is thereby greatly increased.

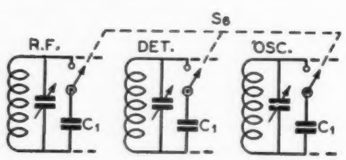


Figure 1.
Method of connecting additional padder condensers across broadcast coils of auto set for marine-band operation. C_1—.0001-μfd. mica, S_6—Triple-pole single-pole switch.

Through the removal of the power supply from the receiver, there is opened a space that is large for all the additional equipment that is required for the u.h.f. portion of the unit.

The next step is to remove one-tenth of the windings from the oscillator, detector and r.f. coils of the auto set. This brings the upper frequency range of the set to slightly above 2000 kc., thus allowing the 160-meter amateur band to be covered by sacrificing the lower-frequency broadcast stations. But, by the use of a set of three padding condensers that can be shunted across the three b.c.l. coils of the set by a triple-pole single-throw switch, the range of the set is extended through the broadcast band and down to about 380 kc. Another addition to the versatility of the set. This method of connecting the padders across the b.c.l coils is indicated in figure 1.

U.H.F. Operation

Two additional tubes with their associated coils, condensers, resistors, switches, and an audio transformer are added to the original complement of the auto set. A 36 is used as a space-charge detector-mixer for 28-Mc. operation, and a 37 is used as high-frequency oscillator when the receiver is operating as a u.h.f. superhet, and as a self-quenched oscillator when used as a superregenerator on ten and five. When the 37 is used as a superregenerative oscillator in the latter mode of connection, the plate voltage is still applied to the 36 but there is nothing connected to its input or output circuits.

The Switching Arrangement

Switches S_1, S_2, S_3, S_4, S_5, and S_6 accomplish the complicated business of switching the receiver from one mode of operation to another. Switch S_1, located in the grid return of the 37 oscillator-superregenerator, changes the value of the grid-leak on this tube from about 20,000 ohms when operating as the h.f.o. of the superheterodyne, to 100,000 ohms when the tube is operating as a superregenerative detector on ten and five.

Switch S_2, a s.p.d.t. toggle in the plate circuit of the 37 tube, connects the plate return of this tube directly to the power supply when the receiver is operated as a superhet, or it forces the plate current to pass through the primary of an audio transformer whose secondary is in the grid circuit of the 42 when the set is operated as a superregenerator. When S_2 has been thrown to this latter connection, S_5, controlling the heaters of all the tubes except the 42 and the 37, has been opened; thus the only source of audio for the grid of the 42 must come from the 37 detector.

Switch S_3 is an on-off switch in the plate circuits of the 37 and 36 tubes used in the u.h.f. end of the receiver. This switch is opened when the balance of the auto set is to be used as a 160-meter receiver, as a ship-band receiver or on the broadcast band.

Switch S_4 is the antenna switch which throws the external fish-pole antenna to the desired input circuit depending upon what type of operation is desired. When it is thrown to A, the set is to operate as a ten-meter superhet; when thrown to B, the set is capable of superregenerative operation on ten and five; and

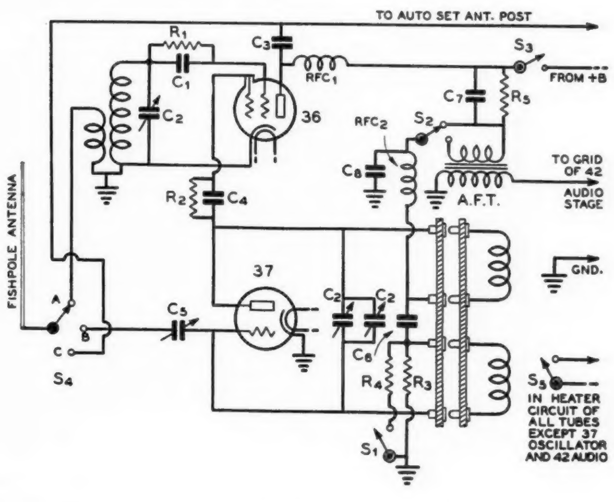


FIGURE 2.

C_1—.0001-µfd. mica condenser
C_2—20uµfd. midget variable condensers
C_3—.00025-µfd. mica condenser
C_4—.00005-µfd. midget mica condenser
C_5—Insulated hookup wire, twisted for 3″
C_6—.0001-µfd. mica by-pass condenser
C_7—1.0-µfd. 400-volt tubular
C_8—.002-µfd. mica condenser
R_1—500,000 ohms, ½-watt resistor
R_2—250,000 ohms, ½-watt resistor
R_3—100,000 ohms, ½-watt resistor
R_4—25,000 ohms, 1-watt resistor
R_5—20,000 ohms, 1-watt resistor
RFC_1—85-mh. r.f. choke
RFC_2—2.5-mh., 125-ma. r.f. choke
S_1—Detector superregeneration or straight oscillator switch
S_2—Audio switch for superregenerative or straight operation
S_3—U.h.f. front end on-off switch
S_4—Single-pole three-position antenna switch
S_5—Heater circuit on-off switch
AFT—3:1 audio transformer
Coils—See text for information

when placed upon C, the set may be operated upon the broadcast, 160-meter or marine bands.

Switch S_5 has been mentioned before; it is the switch which removes the filament power from the tubes that are not used when the 37 and 42 are operating as a superregenerative receiver.

Switch S_6 (figure 1) is a triple-pole single-throw switch that places the .0001-µfd. padder condensers across the oscillator, r.f. and detector coils of the b.c.l. part of the receiver when it is desired to receive the upper portion of the broadcast band and the 600-800 meter marine band.

Ten-Meter Superhet Operation

When the entire receiver is operated on the 28-Mc. band as a superheterodyne, the complete unit is running as a triple-detection double-i.f. set. The original i.f. of the auto set is 260 kc., and the front end of the b.c.l. part of the receiver is tuned to 1600 kc. Thus we get the advantages of both high and low i.f. and are not bothered by the disadvantages of each. The high frequency (1600 kc.) gives us good image rejection and the low (260 kc.) gives us good gain and high selectivity. A small amount of image interference may be experienced at twice the high i.f. from the desired signal (3200 kc. away), but since this interference will be out of the ten-meter band it ordinarily will not bother. If by any chance, it becomes bothersome, an acorn-tube r.f. stage will completely eliminate the trouble.

U.H.F. Coils

The plug-in oscillator coils for the 37 tube are wound of no. 14 wire, self supporting, and are mounted upon small strips of bakelite. Banana plugs and jacks are used as connectors between the coil strip and the receptacle strip of the 37 stage. Only two coils are needed: one for five and the other for ten-meter operation. The ten-meter coil will do both for superhet and superregen operation due to the two 20-µµfd. tuning condensers across this coil. The oscillator is operated at a frequency 1600 kc. *lower* than the 36 mixer for superhet operation by turning the second 20-µµfd. tuning condenser slightly *in* until the oscillator and mixer are aligned.

Since, at the present time, the receiver is used as a superhet only on ten, the first detector coil is soldered to its tuning condenser. If it is desired also to operate superhet on the 56-Mc. band, this coil can be made plug-in.

Coil specifications are not given since they will be subject to considerable variation in individual adaptations. Conventional values as given in the "RADIO" HANDBOOK will serve as a guide in winding these coils, but cut and try methods will be required to align them properly.

Shielding

As a last word let it be said that shielding is quite important in a receiver of this type due to the high gain of the auto set and to the fact that two oscillators will be operating at the same time when u.h.f. superhet operation is employed. Switch S_4 should be especially well shielded.

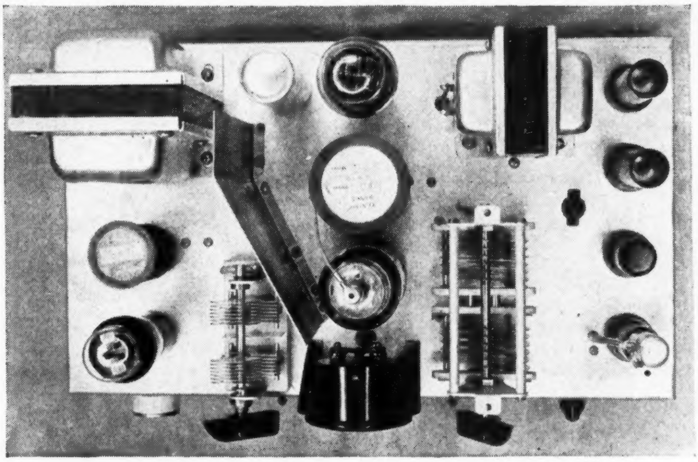
QSL CARD CONTEST RESULTS

Above are illustrated eight of the most attractive of the many cards received in the recent QSL Contest as announced in the January, 1938, RADIO. In the opinion of the judges, the first prize, a Taylor 814, goes to W8NF of Wayne, Michigan, for the distinctiveness of the design of his card.

Second prize, a 4-μfd. 600-volt filter condenser, was awarded to W8JZ, Mount Pleasant, Pa., for the very effective simplicity and cleanness of design shown in his QSL card.

However, all the cards shown on this page and a great many others not illustrated, scored so high that the judges did a great deal of head-scratching before they arrived at a decision.

An All-Band, 20-Watt, Phone-C.W. Transmitter—5 to 160 Meters!



"THE MIGHTY MITE"

By JOHN R. GRIGGS,* W6KW

"Build me a complete phone and c.w. transmitter for all band operation and keep the cost down as much as possible . . . say about $35!"

That was the order recently given to the author, who, with certain misgivings, undertook to satisfy the demand and surprised even himself by developing a small, compact rig that is as efficient on 5 meters as it is on 160! In fact, it has even been operated successfully on 2½ meters. It has both phone and c.w. available on all bands and has proven to be extremely flexible in operation—band-changing can be accomplished in only 30 seconds. And best of all, it may be built at a total cost, exclusive of tubes, microphone and crystal, not exceeding $35.

It will prove ideal for the newcomer to the "ham" game, and many an old timer will find it extremely handy for local rag-chews, either on 5 or 160, for portable use or for experimenting on various bands with low power.

Construction

In designing this small transmitter, all the requirements that would be demanded of such a unit were outlined at the outset. First was the problem of flexibility, with efficiency and economy the next factors to be considered.

Thus it was that plug-in coils were chosen for band coverage. Higher efficiency on the various bands is achieved by the use of a simple arrangement by which the L/C ratio is kept closer to correctness on all bands.

In accomplishing this a circuit was employed which requires the use of a two-section condenser in both the crystal oscillator and final amplifier plate circuits. To explain the operation, the two sections of the split-stator condenser are connected to the coil socket in such a manner that the various combinations may be utilized simply by making the proper connections within the coil form. In the 160-meter oscillator coil, for example, both stator sections of the condenser are connected in parallel, making a total capacity of 200 μμfd. to tune this coil. But on the other bands only one of the 100-μμfd. sections is used (by a different set of connections) to tune them.

In the r.f. amplifier a dual 55-μμfd. condenser is used. By connecting the two sections in parallel a total capacity of 110 μμfd. is available to tune the 160- and 80-meter coils. Then, by using only one of the two sections, the 40- and 20-meter coils are tuned by a maximum capacity of 55 μμfd. And, by connecting the two sections of the condenser in series as a split-stator, approximately 30 μμfd. of capacity is available to tune the coils for the 28- and 56-Mc. bands.

Since the bottom end of the four lower fre-

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*3575 Boston Avenue, San Diego, Calif.

quency coils must be returned to ground for best efficiency, a .002-μfd. mica condenser (C_{14}) is included in these coils and is plugged into the circuit in the proper position when the coil is inserted. This condenser is not used in the two higher frequency coils since both ends of the coil are floating on these bands. The r.f. return is obtained through the grounded rotor of the split-stator condenser.

Metering

An economy feature of the rig is the use of only one meter to indicate the plate currents of the oscillator, the final amplifier and the modulator. A single meter (0-100 ma. d.c.) with a new type of switch now readily available comprise the metering circuit. Through this arrangement it is possible to note instantly the current flowing in each of the three above circuits merely by switching the milliammeter into the desired circuit. The only disadvantage of this metering arrangement is that all circuits to be metered must be operating from a common plate supply; but since that is the case in this particular rig, the arrangement operates perfectly. The switch referred to is the Yaxley 1313L.

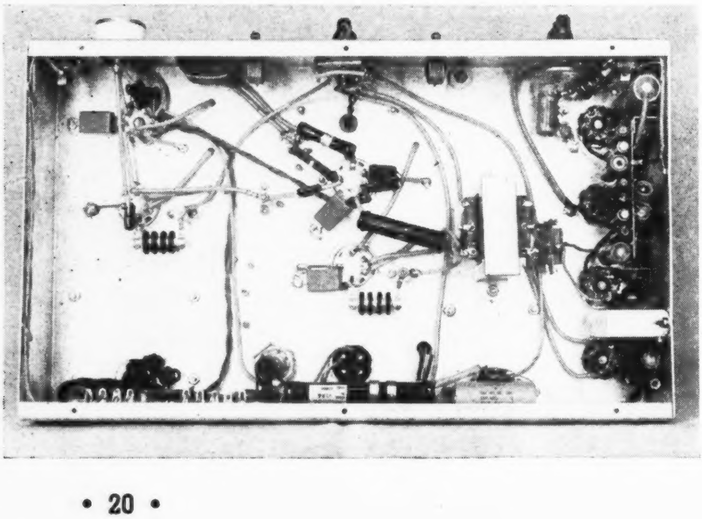
Actual construction of the unit is made on a metal chassis measuring only 10"x17"x3". This size makes the transmitter ideal for rack mounting, and yet it is small enough, being complete in itself, to be readily adapted to portable operation by mounting the chassis in a convenient sized cabinet.

Power Supply

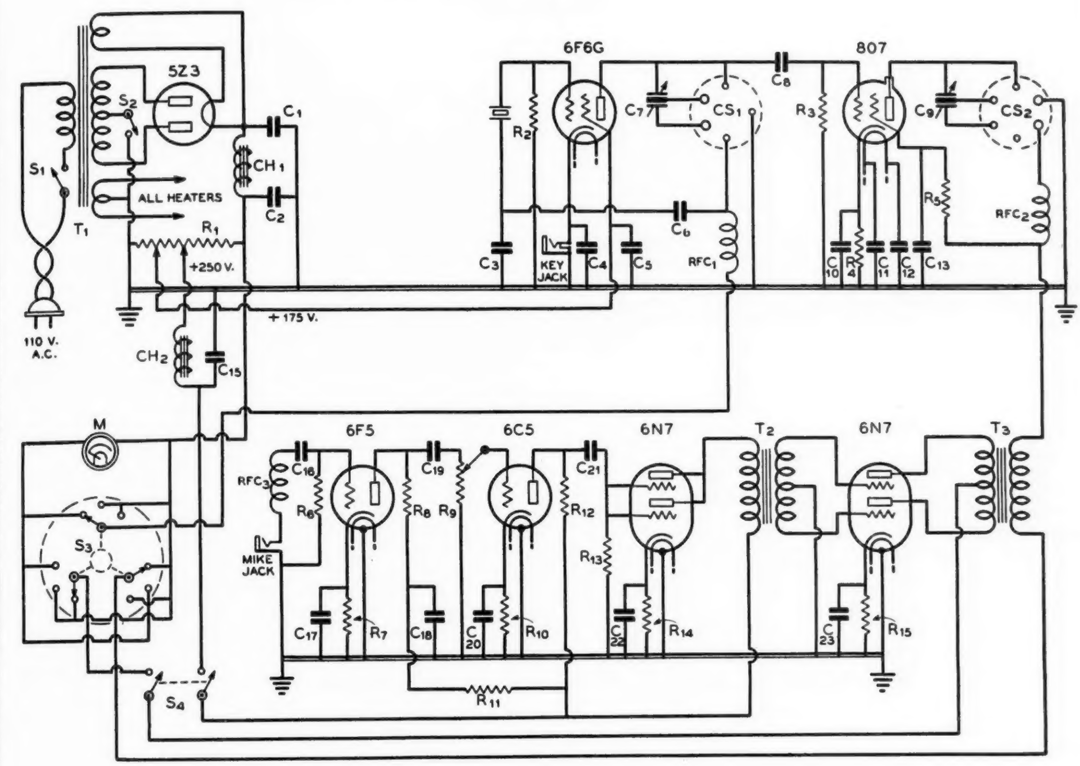
Only one power supply is required, involving a comparatively inexpensive receiver-type transformer, and a single 5Z3 rectifier, plus the usual filter components. The transformer should have a filament winding of 6.3 volts at a current rating of approximately 5 amperes. The plate winding should have a voltage rating of 800-900 volts, center-tapped, at a current rating of 200 ma. One triple 8-μfd. 450-volt filter condenser is used with a 20-henry, 250-ma. filter choke, through which all plate supply current flows. The output of this choke supplies plate power to the modulator and r.f. stages. A bleeder of 20,000 ohms, 50-watt capacity, is placed across it to ground, to improve regulation. This is tapped at 250 volts for plate supply to the speech stages; this voltage is filtered again through a 30-henry 30-ma. choke and an 8-μfd. 450-volt condenser to insure humless operation of the low-level speech stages. The bleeder is also tapped at 175 volts for the screen grid of the crystal oscillator.

R.F. Portion

The ever-present economy factor, plus the problem of flexible operation, made it necessary to limit the r.f. section to two stages. After thoroughly experimenting with the new Jones "sure-fire" crystal oscillator (April, 1938, RADIO) it was decided to incorporate this circuit in the transmitter, utilizing a 6F6G as the oscillator tube. This tube is operated with full 400 volts on the plate, and, as stated in the previous paragraph, 175 volts on the screen grid. These voltages seemed to give the best operation on all bands, although somewhat less plate voltage could be used on the lower frequencies where the power output of the oscillator is greater.



The comparative simplicity of the under-chassis wiring is shown in this view. The meter switch can be seen in the center of the front drop of the chassis and the mounting plate for the speech-amplifier resistors and condensers can be seen along the right-hand edge.



C_1—8-μfd. 450-volt electrolytic
C_2—16-μfd. 450-volt electrolytic
C_3—.00035-μfd. mica
C_4—.0001-μfd. mica
C_5—.01-μfd. mica
C_6—.002-μfd. mica
C_7—100 μμfd. per section, split-stator variable
C_8—.0001-μfd. mica
C_9—55 μμfd. per section, 3500-volt spacing split-stator variable
C_{10}—1.0-μfd. 400-volt paper
C_{11}, C_{12}—.002-μfd. mica
C_{13}—.01-μfd. mica
C_{14}—.002-μfd. mica (in 160-, 80-, 40-, and 20-meter coils)
C_{15}—8-μfd. 450-volt electrolytic
C_{16}—.05-μfd. 400-volt tubular
C_{17}—10-μfd. 25-volt tubular
C_{18}—4-μfd. 450-volt electrolytic
C_{19}—.05-μfd. 400-volt tubular
C_{20}—10-μfd. 25-volt tubular
C_{21}—.05-μfd. 400-volt tubular
C_{22}—25-μfd. 25-volt tubular
C_{23}—10-μfd. 25-volt tubular
R_1—20,000-ohm, 50-watt voltage divider
R_2—50,000 ohms, 1 watt
R_3—100,000 ohms, 1 watt
R_4—1250 ohms, 10 watts
R_5—50,000 ohms, 3 watts
R_6—2 megohms, 1 watt
R_7—2000 ohms, 1 watt
R_8—250,000 ohms, 1 watt
R_9—500,000-ohm potentiometer
R_{10}—5000 ohms, 1 watt
R_{11}—100,000 ohms, 1 watt
R_{12}—150,000 ohms, 1 watt
R_{13}—500,000 ohms, 1 watt
R_{14}—1000 ohms, 1 watt
R_{15}—100 ohms, 10 watts
$RFC_{1, 2, 3}$—2.5-mh. 125-ma. r.f. chokes
S_1—Main a.c. line switch
S_2—D.c. on-off switch
S_3—3-circuit, 3-position meter switch
S_4—D.p.s.t. phone-c.w. switch
M—0-100 d.c. milliammeter
T_1—800-900 c.t., 200 ma.; 6.3 volts, 5 amps.; 5 volts, 3 amps.
T_2—Class-B input to single 6N7
T_3—Class-B output from 6N7 to 8000-ohm load, or to variable load
CH_1—20-hy., 250-ma. choke
CH_2—12-hy., 30-ma. choke
CS_1—Oscillator coil socket
CS_2—Amplifier coil socket

As Frank Jones stated in his article concerning the oscillator circuit,[1] the value of the condenser by-passing the crystal to ground is critical and some adjustment may be necessary. However, a value of .00035 μfd. seemed to effect the best operation on all bands.

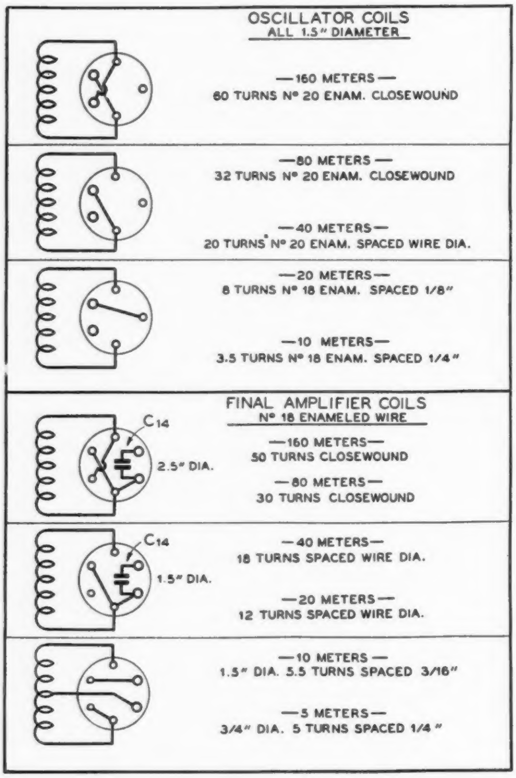
Doubling in the plate circuit is accomplished merely by replacing the coil (at crystal frequency) with one of twice that frequency. Tuning for harmonic operation should be done carefully as the peak will be quite sharp.

Keying is accomplished by inserting a jack for a key plug in the cathode circuit of the oscillator.

Coupling to the r.f. amplifier is accomplished by the time-tried capacitive method, using a mica condenser of .0001 μfd. in value. This value is satisfactory on all bands.

Because of the fact that the amplifier must withstand modulation without reflecting an ap-

[1] "A 'Sure-Fire' Crystal Oscillator," Frank C. Jones, p. 47, April, 1938, RADIO.



preciably varying load on the oscillator, a tube of extremely low driving power requirements was desired. And further, it was preferred that this tube be one requiring no neutralization, an important consideration in an all-band transmitter. The RCA-807 was found to comply in all respects.

Shielding

Shielding between the oscillator and final stages is necessary as the plug-in coils utilized are placed in the same plane for convenience and therefore have similar fields. The small plate of shielding, however, is easy to arrange, and does an effective job of isolating the two stages. To aid further in isolating the elements of the 807 from stray r.f. voltages, it is advisable to shield the tube itself by a metal can extending from the chassis up to the bottom of the tube's plate. This is effective in preventing interference in the 807's grid circuit from the nearby plate tank condenser. The shield also reduces the effective internal capacity, allowing for increased efficiency on the higher frequency bands.

A cathode resistor of 1250 ohms, 10-watt rating, is used in the cathode circuit of the 807 to bias the tube to a safe level for c.w. operation (when excitation is intermittent) and to assist the grid leak bias for the best phone operation. Filament by-pass condensers are placed at the base of the 807 socket, and the center-tap of the filament winding is grounded at the transformer.

Coils

Information on coils used is given in the chart accompanying this article. However, it is well to remember that the coils should be wound so that the "hot" end of the coils (plate end) should be at the top of the form, farthest away from the chassis. Plate caps for the 807 are placed on leads soldered to the tops of the windings of the various final tank coils.

Care should be taken in the layout of the transmitter that both the oscillator and final coils are placed in such a manner as to be one diameter distant from all metallic objects nearby, such as transformers, chokes and condensers or shields.

Isolantite sockets are used throughout in the r.f. section, both for tubes and for coils. Bakelite sockets, however, are suitable in all other cases, including the crystal mounting. Incidentally, it was found advisable to remove all the clips from the 5-prong socket used for the crystal mounting, except for the two used to make connections. This prevents getting the crystal in the wrong position.

Two crystals can give all-band operation. A 160-meter crystal will give harmonic operation in the oscillator to 80 meters and doubling in the final to 40. A 40-meter crystal will allow doubling to 20 meters in the crystal stage and to 10 in the final. Good output can be obtained on 5 meters (when using a 40-meter crystal) by quadrupling in the final stage. It has even been found that a good ten watts output could be obtained on ten meters by using an 80-meter crystal, doubling in the oscillator to 40 and quadrupling to 10 in the final. Excellent five-meter operation may be obtained by use of a 10-meter crystal, although a 20-meter crystal can be used, and it has even been possible to make this transmitter deliver about 5 watts output on 2½ meters!

Speech and Modulator

As the transmitter is designed for an input of approximately 20 watts, the speech amplifier and modulator must be capable of about ten watts audio output. Keeping the economy factor in mind, it was decided to use three

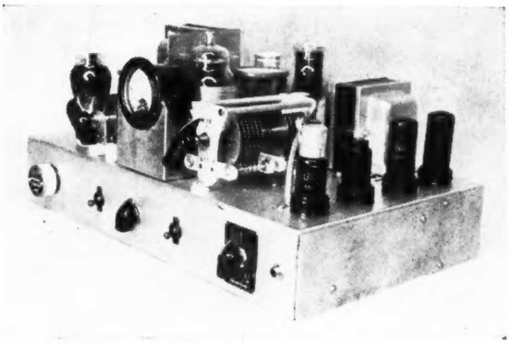
stages of speech amplification with a 6N7 as a class-B modulator. Provision was made for crystal microphone input, thus insuring good speech quality, and all three stages of speech, a 6F5, 6C5 and 6N7, are resistance coupled. Transformer coupling from the 6N7 class-A driver is used to achieve the proper step-down ratio to the grids of the 6N7 class-B modulator.

It will be noted that there is an r.f. choke in series with the microphone lead at the jack. This is sometimes not necessary but is consistent with good practice. All resistors and by-pass condensers are mounted on a bakelite mounting strip, at one end of the chassis. Care should be taken to isolate the speech leads (especially the input stages) by means of shielding and to place them as far as possible from any r.f. leads. Both the 6F5 and the 6C5 are connected as straight triodes although decoupling resistors are used to reduce possibility of audio feedback. The gain control operates in the grid circuit of the 6C5. The output of this stage is fed into the 6N7 class-A driver with the plates and grids connected in parallel. This gives ample power output to drive the grids of the following 6N7 class-B modulator.

Checking the Modulator

To check the operation of the 6N7 modulator, the meter may be switched into the plate lead, and static plate current should read 35 ma. It will be noted that because of the 400 volts used on the plates of the 6N7 modulator, it is necessary to bias the tube through a 100-ohm 10-watt wirewound resistor which is by-passed with a 10-µfd. 25-volt condenser. This condenser is used to by-pass audio frequencies, as is the 1 µfd. used across the 125-ohm resistor in the 807 cathode circuit.

Output of the 6N7 modulator is fed through a modulation transformer to the plate and screen grid circuit of the final amplifier, an RCA-807. It is important that a proper modulation transformer be chosen if correct operation of the modulator is to be achieved. One firm manufactures a variable impedance ratio transformer of this type which sells at a reasonable price. The approximate load presented by the r.f. amplifier is 8,000 ohms, when fully loaded to normal 20 watts. The secondary of the modulation transformer should be designed to carry the plate current of the r.f. amplifier, which should not exceed 65 ma. Typical operating conditions should show the 6N7 modulator drawing 100 ma. on peaks.



Angle front view of the complete transmitter.

R.f. feedback in the speech is negligible, even on the high frequency bands, *except when the r.f. unit is not loaded to an antenna or dummy load!* It is important to have sufficiently good antenna coupling to load the amplifier properly when operating on 5 or 10 meters. When such is the case, no trouble will be experienced with r.f. feedback in the speech. Grounding the metal chassis aids materially in reducing hum in the speech or carrier, *except* where it is necessary to run a long lead to ground. In such cases, it is usually better to leave it ungrounded.

Tuning

In first placing the transmitter in operation, the speech and modulator section may be temporarily disregarded, and full attention given to the r.f. portion. It is quite permissible to leave the speech and modulator tubes in their sockets, but the switch which disconnects their plate power should be in the off position before starting the following series of tests.

With the oscillator tube (6F6G) in its socket, plug in crystal and coil for same frequency, and place meter (by means of switch) in crystal plate circuit. Then apply B power. Rotate crystal tank condenser until a dip in current is noticed. Then tune for the greatest dip. Crystal oscillator plate current will vary, according to frequency used, anywhere from 11 to 30 ma. If no dip is found, check coils and connections. If connections are okay, and crystal is known to be active, try adding small fixed condenser (about .00005 µfd.) across coil. If unable to find dip, then remove the condenser and short out several turns of the coil and try again. This should not be necessary, however, if the coil specifications are followed

[*Continued on Page 74*]

Long Range DX *Prediction*

By E. H. CONKLIN*

It might be said that there are two general methods of predicting the future—omitting such things as crystal balls—a close study of variations of the data being studied with a view to extending the variations and, secondly, a study of other factors which may have a similar movement or a causal (not casual) relationship to the thing in which we are interested. An example of the first is the "dx cycle" from which conditions a few months ahead have been predicted with fair accuracy; and of the second, attempts to show what is going to happen to our bands based on the change in sunspot activity.

Amateurs appear to have given but little thought to the comparison of radio conditions with other data such as variations in the earth's magnetic field and sunspots, although a few isolated workers have made a study of these things. There has been almost a complete absence of any quantitative record of radio conditions in amateur publications, going back a few years. However, acknowledging that the layers of the ionosphere are very important to radio, we can turn to a paper written by Elbert B. Judson,[1] W3AFU-W3GBI, in 1936 and extend the study to the present time. By determining the ionosphere layer that is supporting transmission at a given frequency, predictions become possible if changes in the layer can be predicted.

Layer Height

Of the more important layers, the E and F_2 are of most interest to us. Ordinarily, the E layer which has a virtual height of about 100 to 120 kilometers (varying around 70 miles), is the medium for transmission on our lowest frequency bands only, although occasionally strong sporadic reflections take place from it permitting it to control transmission even down to five meters. Of most interest is the F_2 region, about 200 to 500 kilometers (124-310 miles) in virtual height, depending on the time of day and the season, and the F layer which is generally formed at night by the combination of the F_1 and F_2 layers.

From ionosphere measurements, two important types of data are obtained[2]: the virtual height of the layers, and the penetration frequency or critical frequency above which reflections will not return the signal directly downward.

Zurich Sunspot Numbers

Mr. Judson used the Zürich provisional sunspot numbers in comparison with the magnetic character number for each day as reported by the Cheltenham Magnetic Observatory of the U.S. Coast and Geodetic Survey. The ionosphere data of the National Bureau of Standards for noon, Eastern time, was used because the majority of observations during 1930, 1931 and 1932 were taken around that time, although the noon values are not necessarily the daily maximum points.

Critical frequencies from 1934 through 1937 were generally increasing, as were sunspot numbers and magnetic activity. An examination of individual days in 1934 and 1935 showed no consistent agreement between the curves for critical frequency and those for the cosmic data.

Critical Frequency

Monthly averages are plotted in figure 1. The critical frequency and virtual height curves show the marked seasonal variation repeating each year and usually having high daytime critical frequencies around February and November, with much lower values in the summer. It is this seasonal factor which appears to govern 28-Mc. transmission across the Atlantic. It is interesting to note that the virtual height is generally low when the critical frequency is high, a condition which also has been found to

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*Associate Editor, RADIO.

[1]E. B. Judson, "Comparison of Data on the Ionosphere, Sunspots, and Terrestial Magnetism," *Nat. Bur. Stand. Jour. Res.*, vol. 17, pp. 323-330; September, 1936. Also, the same paper will be found in *Proc.* I.R.E., vol. 25, p. 38; January, 1937.

[2]E. H. Conklin, "New Ionosphere Broadcasts," RADIO, October, 1937, p. 26.

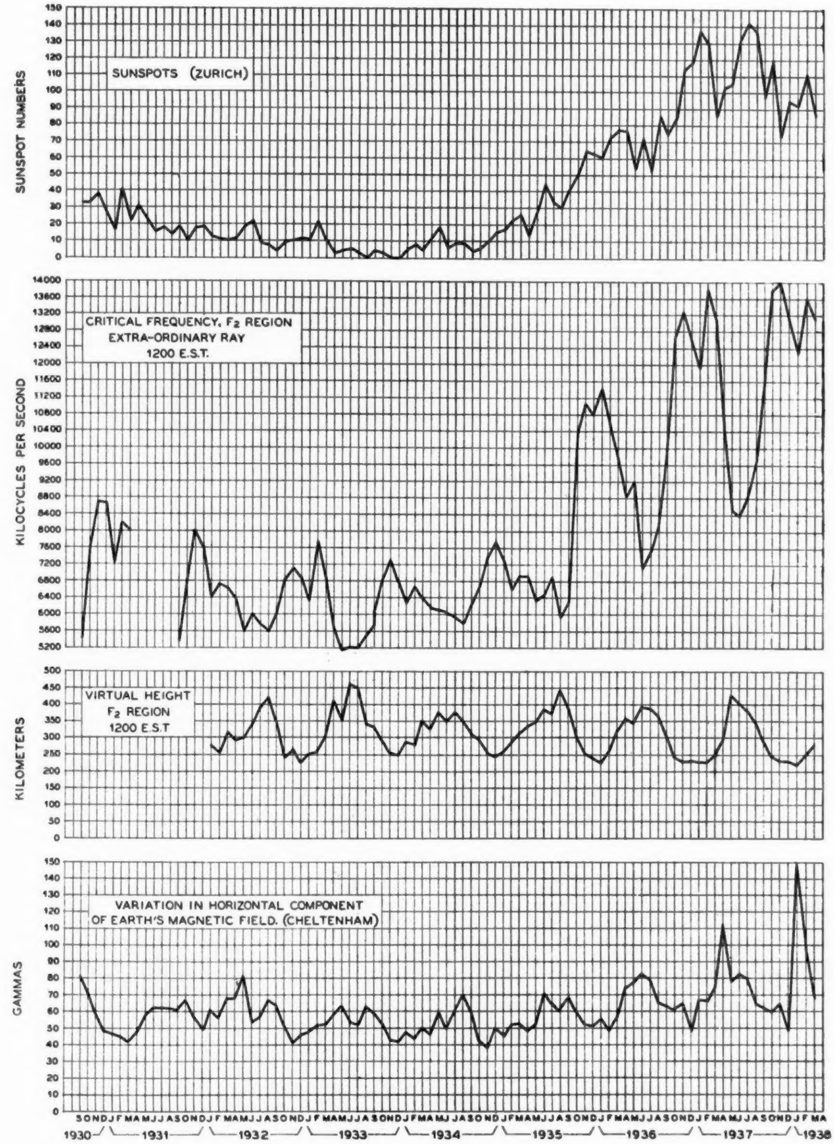

FIGURE 1.

hold for individual days. The curve of magnetic disturbances follows fairly well the seasonal curve of virtual heights, but beyond the seasonal factor the correlation does not appear great. A comparison of the sunspot curve with that for critical frequency shows no certain correlation for corresponding months, even if the seasonal factor is eliminated from the ionosphere data, but there is some similarity between the general long-term trends.

Annual averages of sunspot and critical frequency data are next considered. Here there is a marked similarity, as seen in figure 2, suggesting the possibility of forecasting on an annual basis, for various parts of the sunspot cycle, if the effects of changing F_2 layer critical frequencies are well understood. The maximum frequency which would return to earth would be approximately the value of the critical frequency (at vertical incidence as given) mul-

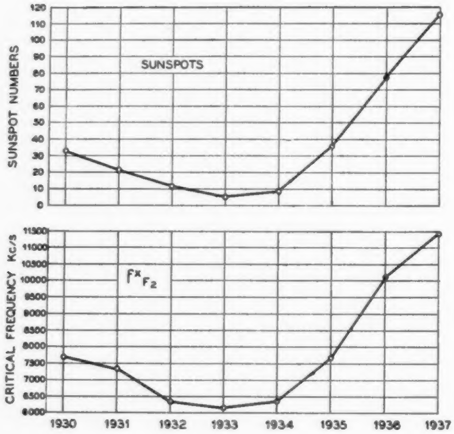

FIGURE 2.

tiplied by the secant of the angle at which the waves strike the layer, for the lowest possible angle of radiation. For the F_2 region, this would mean multiplying by 3 or 4, depending upon the height of the region above ground.

Checking Conditions Against Past Data

Let us compare radio conditions with the F_2 layer curve. It is known that 56-Mc. transatlantic signals have been reported during the last year or two, but not previously since 1927[3], but a somewhat more detailed comparison can be made on lower frequencies.

On 28 Mc., some data is available covering a series of years, in past issues of *R/9*, RADIO, and *QST*. When the band was opened up early in 1928, little time was lost in making some good long-distance contacts which lasted through the winter of 1930. Following that summer, when dx went through its seasonal slump, few stations were active. There was one transatlantic report in each of 1932 and 1933. OK1AW was heard over here in June of 1934, a Canadian was heard in Australia in August, and by the end of the year, W9TJ and ON4AU were making fairly regular contacts, including a 1935 contest number exchange, though other stations did not seem to get in on the fairly good conditions. Australians got through well for a few weeks in the spring of 1935, following which there were two isolated transatlantic contacts in the summer, together with quite a bit of South American work. By the fall of 1935, things opened up for all continents, continuing to date except for the seasonal slump in summer.

On 14 Mc., in 1933 and 1934, the band used to pass out at 5 p.m. in Illinois, not to open again until after sunrise. Europeans, without any interfering U.S.A. signals, were heard on 7 Mc. after seven or eight o'clock in the evening.

Sunspot Lag or Lead

A very important consideration in making predictions will be whether radio conditions precede or lag behind sunspots. One paper[4] suggested that the magnetic activity follows sunspots on the way up but lags nearly two years on the way down, but the F_2 layer data on an annual basis looks like a high correlation, though the decline in 28 Mc. conditions may have preceded the change in sunspots and the F_2 layer. This is possibly attributable to a general discouragement in the 28-Mc. ranks, which was quickly overcome when things began to pick up. The writer is inclined to believe that the F_2 layer curve will give the more accurate indication.

Before making any long-range predictions, we point out that averages are simply averages —they permit wide variations from day to day. Thus, in the monthly data, there may have been quite a few days around November, 1932; February and November, 1934; and December, 1935, when the ionosphere measurements indicated 28-Mc. dx to be possible. At the recent high levels of critical frequencies, the *average* value itself was sufficient to support 28-Mc. transmission, so that there have been but few winter days in the past several years when the band failed to open for dx, other than when severe magnetic storms occurred, making very high frequency work impossible as a rule.

Another factor worthy of mention is that the best signal strength may occur on a frequency that is nearly the highest that will support communication. Thus, foreign 7 and 3.5 Mc. signals may be somewhat weaker now than during a period when the 28- and even 14-Mc. bands are useless.

Without more knowledge of a possible lag in radio conditions behind the sunspot cycle

[*Continued on Page 74*]

[3]E. H. Conklin, "5 Meters On Parade," *R/9*, October, 1935, p. 40.

[4]A. L. Durkee, "Forecasting Sunspots and Radio Communications Conditions," *Radio Digest*, January and February, 1938, p. 3; from Bell Laboratories *Record*, December, 1937.

AN ALL-WAVE TUNER PANEL

By RAYMOND P. ADAMS*

A number of amateurs have asked the writer to recommend a suitable circuit and layout for the construction of what might be called an auxiliary or second receiver. They wanted one which could serve both as an emergency communications receiver and as a general service job, one which would involve a very moderate parts cost in the building, would operate as well as the best of factory-built receivers and would have somewhat greater flexibility of control.

The set also should present a commercial appearance and should be capable of use with existing a.f. amplifiers. Apparently the average ham feels that a second receiver is well worth having on hand, even if it's to be used only occasionally and for the reception of broadcast programs and various other transmissions beyond the frequency reach of his regular communications job.

What the writer believes to be such a circuit and layout are described here. Every effort has been made to keep the design as simple and as inexpensive—yet as flexible and modern—as possible.

Although the receiver is not to be confused with a kit-model of somewhat similar appearance, it nevertheless features the completely built up and pre-aligned r.f. assembly or "front end" which that model incorporates, plus the stamped chassis recommended for the kit. These two standard, made-up items are handled by most jobbers and their use here greatly facilitates the business of construction.

Tuning Range

Some hams insist upon rather extensive tuning range in a secondary or auxiliary receiver. They want broadcast band coverage for entertainment purposes, long-wave coverage primarily so that they may tune in on airport weathercasts, and as much extension as possible toward the high frequency end of the spectrum. Others care little about such things as weather reports and simply desire something which will do an effective job from about 5 to say 200 meters, with the amateur bands well spread, and with standard broadcast coverage featured in addition if possible. But whatever they

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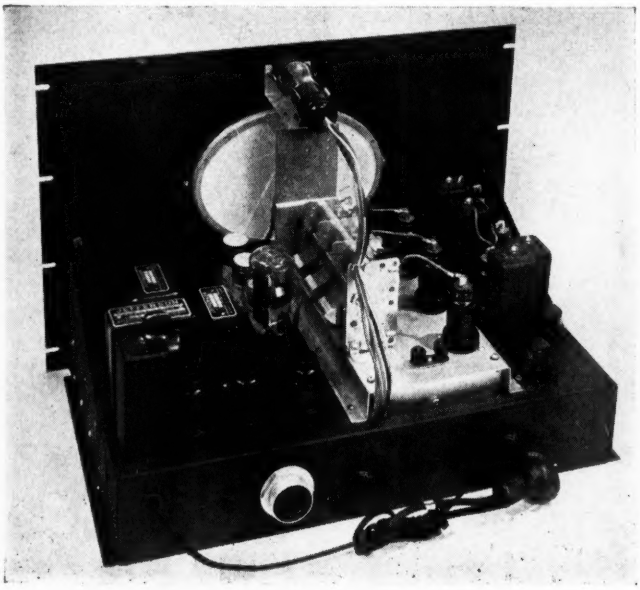
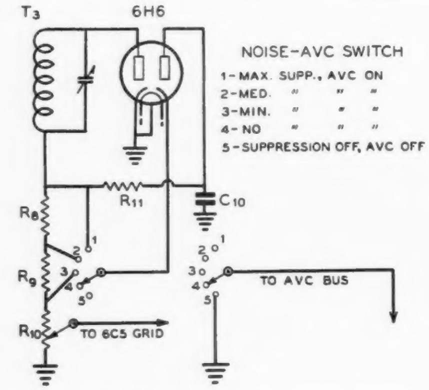


A flexible, easily-built, moderate cost assembly designed for general service, emergency, and "second-set" application.



Detail drawing of noise-a.v.c. switch showing operation. Values given on page 31.

are looking for, they certainly as a rule aren't very enthusiastic about the idea of building up their own "front end," with its complicated array of coils and shielding, nor of precision calibrating a dial scale in terms of frequency for five wavebands.

These problems, of desired range, of r.f. assembly construction, of calibration have been completely and effectively solved by the use of the built-up tuning unit, which is wired, aligned, and equipped with variable condenser, band switch, air trimmed inductances, sockets, interstage shield partitions, self-chassis, r.f. resistors and by-pass condensers and a.v.c. network items. Dial calibration is within 1%. Either one of two complete 5-band assemblies may be employed: one with a range of from 7.5 to 2140 meters or one with a range of from 5 to 555 meters.

R.F. Circuits

The r.f. circuits are strictly conventional, employ the usual 6K7, 6L7, and 6J7 in r.f., mixer, and h.f.o. stages, and, of course, are all wired up. Note that there is no r.f. preselection on the u.h.f. band (7.5 to 20, or 5 to 9.9 meter, depending upon which of the two assemblies is employed).

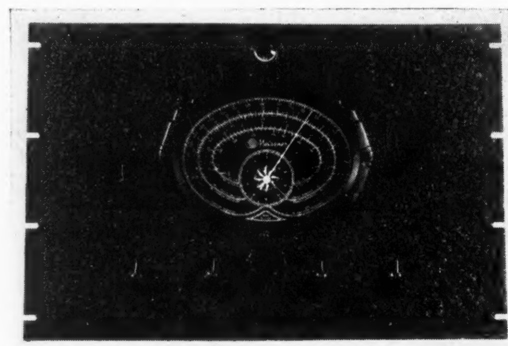
The I.F. Circuits

The intermediate frequency is 456 kc., as might be expected, and two stages are employed. Transformers T_1 and T_2 are both designed for three-point adjustable acceptance (high selectivity, medium, and high fidelity)—primarily so that those occasionally received broadcast programs will be faithfully reproduced, secondarily so that the band-pass may be widened to listen to modulated-oscillator u.h.f. signals. This variation in the acceptance is effected through the overcoupling of primary and secondary windings.

Both tubes are 6K7's; the one in the first stage is both automatically and manually controlled, that in the second is fixed in conductance. All plate and screen circuits are individually by-passed and isolated. Incidentally, the series screen resistors are strictly for decoupling and are not there as voltage drop resistors.

The A.V.C. Channel

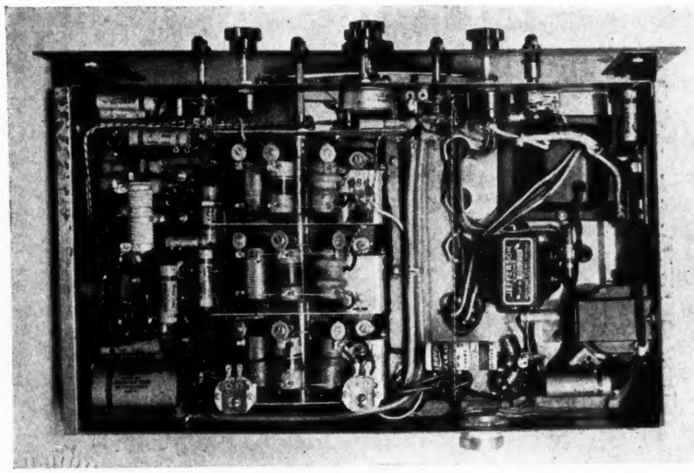
The writer believes that a separate and controllable a.v.c. channel is a practical and usable refinement even in a so-called auxiliary receiver. It gives a receiver really remarkable flexibility of control.



Panel View of the Receiver.

Two tubes are used in the channel: a 6K7 signal amplifier whose number one grid is tied to that of the second 6K7 in the i.f. section; and a 6H6 diode rectifier. Coupling between stages is effected through the medium of a single-tuned transformer (designed expressly for Lamb noise circuit diode feed) and built with a center-tapped secondary winding.

The control voltage related to signal intensity develops across the quarter-meg. resistor in the diode load and is applied to r.f., mixer, and first i.f. stages, except when u.h.f. coverage is selected by the band-switch. A.v.c. voltage is then applied only to the i.f. stage. R_{27}, the diode bias potentiometer, determines the threshold level, or the level of rectified signal which will effect control action. The variable a.v.c. adjustment may be made such that noise voltages, or noise and signal voltages, or simply signal voltages of any desired level will affect controlled stages. In other words, a control



Bottom view of the tuner, in this case built up on the factory-punched chassis. The manufactured coil-condenser tuning assembly is mounted just to the left of the center of the chassis.

action or characteristic may be selected to meet any specific signal, noise, or general operating condition.

The Second-Detector Circuit

The second detector circuit will be familiar to those amateurs who have built the writer's 10-meter station receiver.[1] Its 6H6 is something more than a straight diode rectifier, it acts as a noise limiter or suppressor which automatically attenuates *both* the brief noise impulses which are so troublesome at the higher frequencies and the sharp noise peaks which ride through during the wide-acceptance reception of high fidelity broadcasts.

The noise circuit, an adaptation of the Dickert one, is exceptionally effective, requires few special parts, is self-adjusting to carrier level, is stable and distortionless, and involves no particular complexities of layout.

Note that a switch has been incorporated to permit: position 1—full suppression, slightly affecting modulation peaks; 2—medium suppression; 3—minimum suppression, suitable for high fidelity reception of broadcast; 4—no suppression; 5—no suppression, and a.v.c. off.

The Audio System

The Dickert noise suppression circuit, to be most effective, calls for the use of a diode-biased low-μ first a.f. amplifier. When diode biased, however, such an amplifier must be plate-current limited; it cannot be made to look directly into a low-resistance plate impedance, or the primary of an audio frequency transformer.

[1]October, 1937, RADIO.

The resistors R_{13}, R_{14}, R_{16}, R_{17} have been given average values, and minor departures from these ratings may be advisable under differing conditions of operation.

The output transformer is a very small but efficient affair designed to match a single triode to 200- or 500-ohm lines. Leads from the output receptacle connect, of course, to the secondary winding, with the two extra terminals wired one to the 6C5 cathode and one to the T_6 side of C_{15} to provide for headphone feed or for 6C5 coupling out to the gride circuit of an external power amplifier.

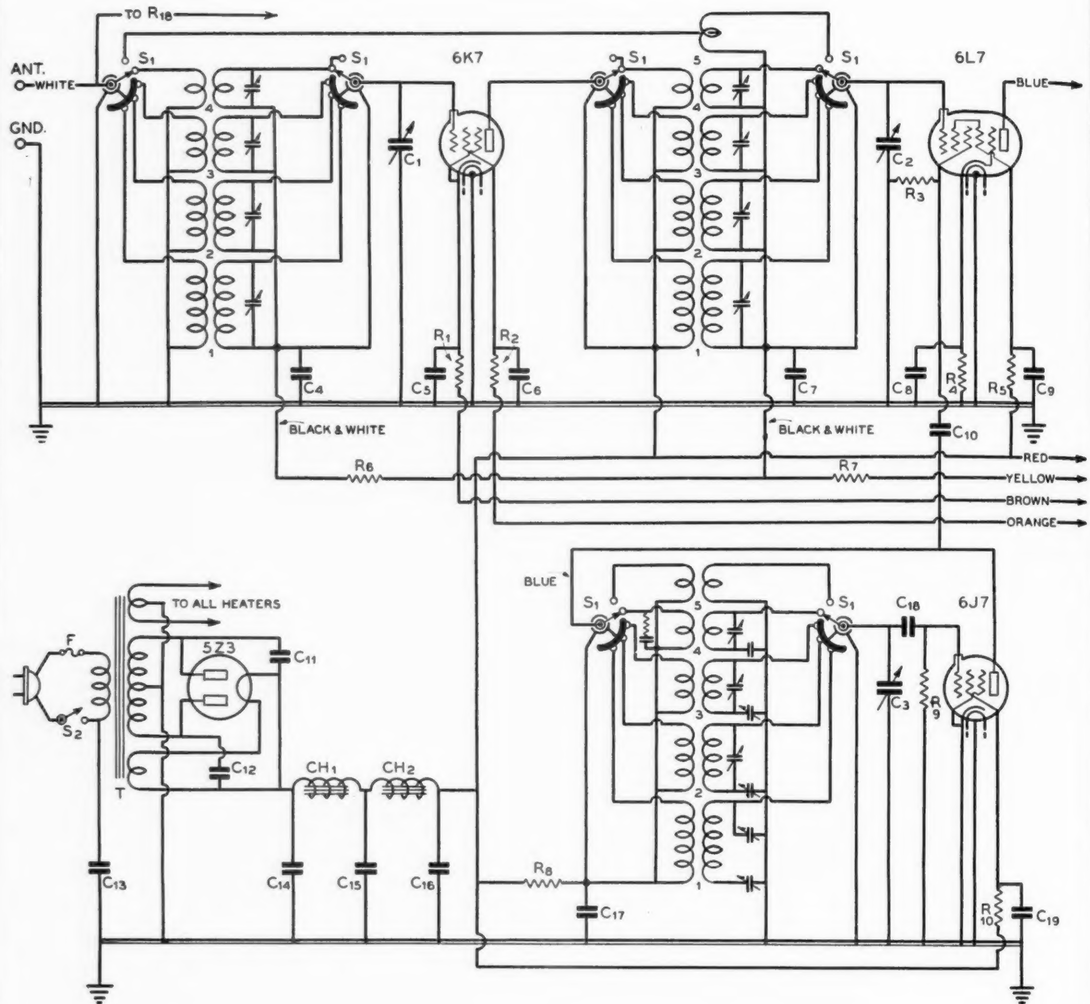
Power Supply

The power transformer is a 60-Ma. job which supplies 320 volts into the input filter capacity C_{14}. CH_1 is a low-resistance input choke and CH_2 a 50-henry, 1400-ohm smoothing affair. Using these chokes the filtered d.c. measured at the high side of the voltage divider is approximately 250 volts.

Layout

Front panel controls, left to right, are for: (top level of pointers) three-point band expansion, band selection, noise-a.v.c. switching, beat oscillator on-off; (lower level of knobs) r.f. fading or tuner gain, a.v.c. adjustment, a.f. level. The knob controls are used most frequently as they afford complete tuner regulation once band, acceptance, and noise adjustments have been made. The a.c. on-off switch, by the way, is on the a.f. pot.

Above chassis layout calls for no discussion; a brief study of the photos should indicate the positioning of "upstairs" components



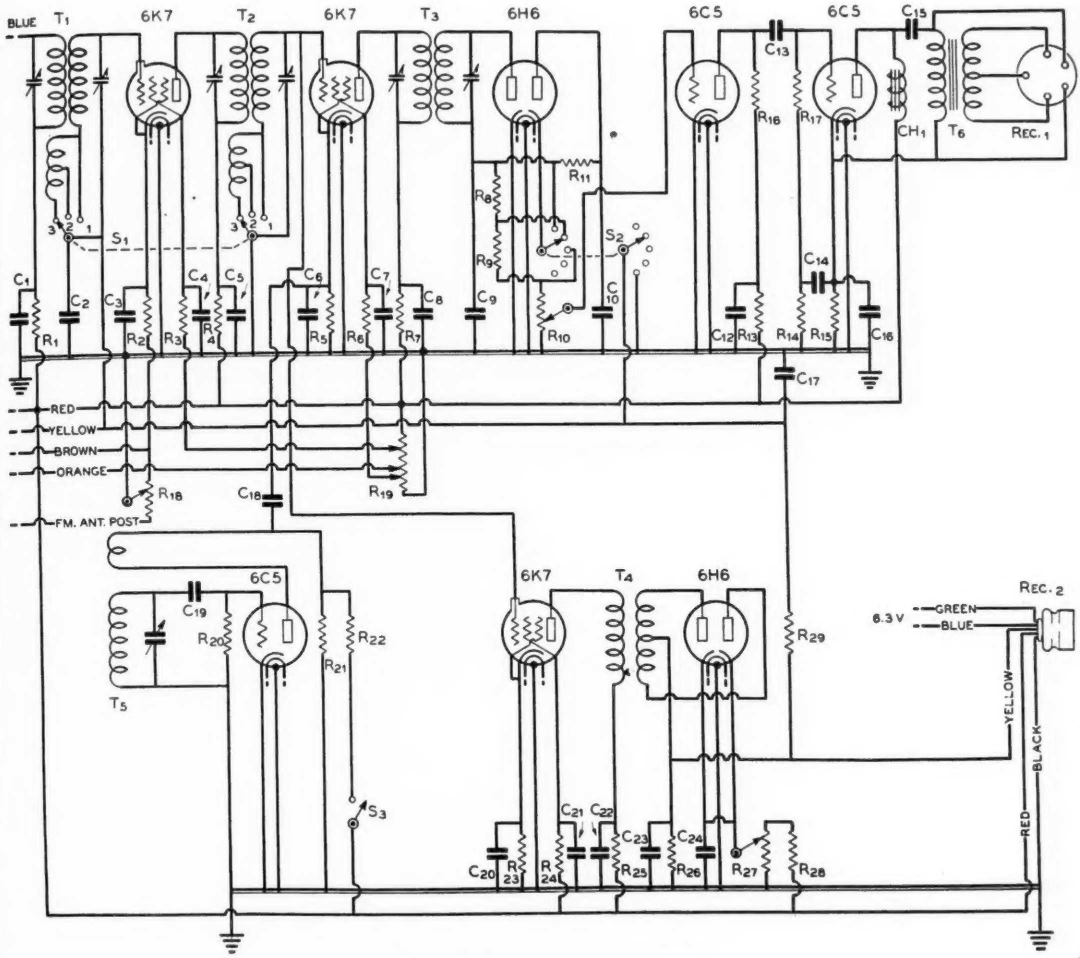
Factory-Wired R. F. Assembly

(All these parts are contained in the assembly and need not be duplicated.)

C_1, C_2, C_3—3-gang tuning condenser
C_4—.05-µfd. 400-volt tubular
C_5—0.1-µfd. 400-volt tubular
C_6, C_7—.05-µfd. 400-volt tubular
C_8—0.1-µfd. 400-volt tubular
C_9—.05-µfd. 400-volt tubular
C_{10}—.0001-µfd. mica
C_{17}—.05-µfd. 400-volt tubular
C_{18}—.00025-µfd. tubular
C_{19}—.05-µfd. 400-volt tubular
R_1—300 ohms, ½ watt
R_2—5000 ohms, ½ watt
R_3—50,000 ohms, ½ watt
R_4—600 ohms, ½ watt
R_5—15,000 ohms, 1 watt
R_6—100,000 ohms, ½ watt
R_7—100,000 ohms, 1 watt
R_8—40,000 ohms, 1 watt
R_9—100,000 ohms, ½ watt
R_{10}—10,000 ohms, ½ watt
S_1—Bandswitch

Power Supply

C_{11}, C_{12}—.002-µfd. mica
C_{13}—.05-µfd. 400-volt tubular
C_{14}, C_{15}, C_{16}—8-µfd. 450-volt electrolytics
T—700 v. c.t., 65 ma.; 5 v., 3 a.; 6.3 v., 2.5 a.
CH_1—2.7 to 8 hy. swing choke, 150 ma. max.
CH_2—50 hy., 60-ma. filter choke
S_2—A.c. line switch

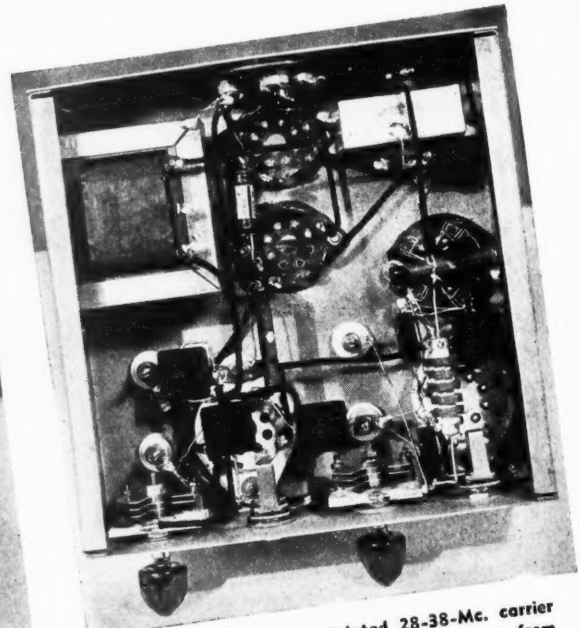


I.F., A.V.C., and Audio Circuits

C_1, C_2—0.1-µfd. 400-volt tubular
C_3—.01-µfd. 400-volt tubular
C_4, C_5—0.1-µfd. 400-volt tubular
C_6—.01-µfd. 400-volt tubular
C_7, C_8—0.1-µfd. 400-volt tubular
C_9—.00005-µfd. mica
C_{10}—1.0-µfd. 400-volt tubular
C_{11}—Omitted from diagram
C_{12}, C_{13}, C_{14}—0.1-µfd. 400-volt tubular
C_{15}—.25-µfd. 400-volt tubular
C_{16}—25-µfd. 25-volt electrolytic
C_{17}—.05-µfd. 400-volt tubular
C_{18}—.01-µfd. 400-volt tubular
C_{19}—.0005-µfd. mica
C_{20}, C_{21}—0.1-µfd. 400-volt tubular
C_{22}—0.1-µfd. 400-volt tubular
C_{23}—.00025-µfd. mica
C_{24}—0.1-µfd. 400-volt tubular
R_1—2000 ohms, ½ watt
R_2—400 ohms, ½ watt
R_3—5000 ohms, ½ watt
R_4—2000 ohms, ½ watt
R_5—1000 ohms, ½ watt
R_6—5000 ohms, ½ watt
R_7—2000 ohms, ½ watt
R_8, R_9—50,000 ohms, ½ watt
R_{10}—100,000-ohm potentiometer
R_{11}—1.0 megohm, ½ watt
R_{12}—Omitted from diagram
R_{13}—50,000 ohms, 1 watt
R_{14}—100,000, ½ watt
R_{15}—2600 ohms, 1 watt
R_{16}—50,000 ohms, 1 watt
R_{17}—500,000 ohms, ½ watt
R_{18}—15,000-ohm potentiometer
R_{19}—30,000-ohm, 30-watt voltage divider with 3 extra sliders
R_{20}—50,000 ohms, ½ watt
R_{21}—5000 ohms, 1 watt
R_{22}—25,000 ohms, 1 watt
R_{23}—400 ohms, ½ watt
R_{24}—100,000 ohms, ½ watt
R_{25}—2000 ohms, ½ watt
R_{26}—250,000 ohms, ½ watt
R_{27}—5000-ohm potentiometer
R_{28}—30,000 ohms, 1 watt
R_{29}—250,000 ohms, ½ watt
T_1, T_2—Band-expanding i.f. transformers
T_3—Output i.f. transformer
T_4—Single-tuned diode output i.f.
T_5—B.f. oscillator coil
T_6—6C5-to-lines output transformer
Rec.$_1$—Line output receptacle
Rec.$_2$—Magic eye socket assembly
S_1—I.f. expanding switch
S_2—A.v.c.-noise silencing switch
S_3—B.f.o. on-off switch
CH_1—250-hy., 5-ma. choke

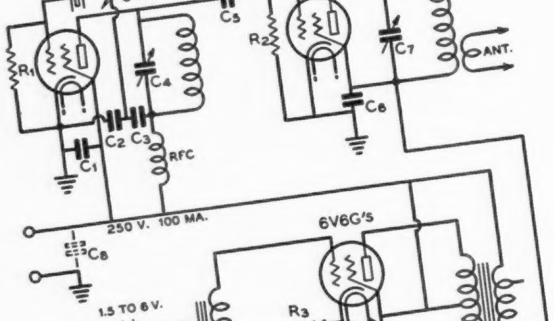
(Continued on Page 75)

For the 28 Mc. Band



Four watts of fully modulated 28-38-Mc. carrier is available from this compact unit when run from a 250-volt vibrator-type power pack delivering 100 ma. A harmonic oscillator is used to drive a plate-screen modulated doubler.

THE GENERAL WIRING DIAGRAM



R_1—100,000 ohms, 1 watt
R_2—250,000 ohms, 2 watts
R_3—400 ohms, 5 watts
C_1—.001-μfd. midget mica
C_2—.00037 ? mica (see text)
C_3—.001-μfd. midget mica
C_4—25-μμfd. midget, ceramic insulation
C_5—.0001-μfd. midget mica
C_6—.001-μfd. midget mica
C_7—25-μμfd. midget, ceramic insulation
C_8—4- or 8-μfd. midget electrolytic by-pass unless on power supply filter
T_1—High ratio single-button mike trans., 50-ohm pri. and 200,000-ohm secondary
T_2—Midget class-B output transformer, approximately 10,000-ohm pri. and 5000-ohm secondary (standard size). 1-1 ratio would be preferable, but not commonly available.

A 9-10 Meter

MOBILE UNIT

By

F. R. GONSETT,*

W6VR

Because they would rather work mobile with local amateurs whom they work regularly from their home stations, many 10-meter amateurs seem to be more interested in 10-meter portable mobile installations than in gear for 5 meters. We see no reason for discouraging the use of 10-meter mobile work, but do suggest that amateurs confine their mobile activities to the extreme high-frequency end of the 10-meter band. In this way there will be less QRM inflicted upon stationary 10-meter stations attempting to work dx. Without a doubt the low frequency edge of the band is *sometimes* slightly better for dx sky-wave QSO's, but for local ground wave work there is absolutely no difference between 28,500 kc. and 30,000 kc. Therefore, there is no justification for amateurs cluttering up the low frequency portion of the band with their portable mobile rigs, especially when much more difficulty will be experienced in getting through because of QRM.

The unit illustrated delivers between 4 and 5 watts of fully-modulated carrier (crystal controlled) with excellent intelligibility, has negligible frequency drift, and is quite compact. The total heater drain is only 1.8 amp., and the total plate current drain is 100 ma. at 250 volts. All tubes are of the same type, simplifying the problem of spare tubes. The latter is quite an important item when several transmitters are used for police work. The unit described makes an excellent 9-meter police installation when the coils are cut down slightly and a 36-meter AT-cut crystal is used instead of a 40-meter one.

Electrical Design

A 6V6G crystal oscillator in the new Jones circuit arrangement is used[1], with the output circuit tuned to twice the crystal frequency. Thus, with a 40-meter AT-cut crystal for operation in the 10-meter amateur phone band, the crystal oscillator plate circuit is tuned to 20 meters. Then the second 6V6G is used as a plate-and-screen-modulated frequency doubler on 10 meters. For operation on the u.h.f. police bands, an AT-cut crystal in the vicinity of 9 Mc. is used; the oscillator plate circuit is tuned to approximately 18 Mc., and the plate circuit of the 6V6G modulated doubler is tuned to approximately 36 Mc.

A pair of 6V6G's connected AB_1 are employed as modulators. Through the use of a set of input and output transformers especially designed for use with a single-button mike, no speech amplification is required ahead of the grids of the 6V6G's. The input transformer has a very high turns ratio (50-ohm primary, 200,000-ohm secondary) and no preliminary stage is needed when the output transformer operates the tubes at a fairly low value of load impedance so that a comparatively large power output is available with small driving voltage.

Power Supply Requirements

The complete unit is designed to operate from a 250-volt 100-ma. plate supply, a 6.3-volt storage battery and one 1½-volt flashlight cell. The plate supply may be either a dynamotor or a vibrator pack as long as it is capable of supplying the power requirements of the rig. Incidentally, although the majority of the common dynamotors and vibrator packs of this class are rated at 300 volts and 100 ma., under full load with a normal filter and with normal drop in the 6-volt supply leads the actual output voltage of the system will be more in the vicinity of 250-260 volts at the full load of 100 ma. Hence, one of these supplies is just about optimum for this rig. In fact, not over 260 volts should be applied to the transmitter as diagrammed, as the screens will run too hot, causing erratic operation.

The normal drain of the 6V6G oscillator is about 30 ma., the 6V6G modulated doubler stage pulls 40 ma. and the push-pull 6V6G's in the modulator draw approximately 30 ma. with no signal. Under heavy voice modulation, the plate current on the modulators will swing up to 40 or 45 ma., but since it is only an intermittent load the 100-ma. supplies will be able to carry it with no difficulty.

The total filament drain of the rig is only 1.8 amperes at 6.3 volts but the current requirements of the dynamotor or vibrator pack are much more stringent. Under normal con-

*Laboratorian, RADIO.

[1] "A Sure-Fire Crystal Oscillator," Frank C. Jones, RADIO, April, 1938.

ditions the drain produced by the plate supply will be 6 to 8 amperes, and heavy leads must be run from the storage battery to the converter.

It has been found best to run the microphone from a different supply source than the main storage battery. In this particular rig, the microphone is run from a single 1½-volt flashlight cell. One of these cells furnishes ample voltage to operate the mike. Through its operation from a separate supply, much of the hash that usually arises from the operation of the microphone and the vibrator or dynamotor from the same supply is eliminated.

If a "grip to talk" microphone is used, the switch in the handle can be connected in series with the microphone, thus cutting off the microphone voltage when the transmitter is not in use. If the microphone voltage is left on continuously, a standard "Little Six" dry cell would be preferable to a flashlight cell. It should be borne in mind that 1½ volts on the microphone is sufficient only if the very high ratio type of single button mike input transformer is used. Ordinary transformers will require more microphone voltage, which results in more current drain and shorter life for the battery or batteries supplying the microphone.

6L6G tubes may be substituted for the 6V6G's with little difference in operation except that the maximum allowable voltage is raised from 250 to 300 volts. The current drain at 300 volts will be in the neighborhood of 120 ma. More than 300 volts cannot be used unless the screen voltage is dropped; otherwise the crystal current is excessive and the screens run too hot. Series dropping resistors can be used for the two r.f. tubes to keep the screen voltage below 300 volts. Using 6L6G's at 450 volts, with series screen dropping resistors, it is possible to obtain 10 watts of carrier.

Important Considerations

The condenser C_2 is somewhat critical. If it is made too small, the crystal current will be excessive and the oscillator may tend to self-excite. If it is made too large, the harmonic output of the oscillator falls off. Usually a .00037-μfd. mica condenser will be about right, though it may be found necessary to use either a .00025 or .0005 μfd. The latter value will give the lowest crystal current, and should be used with an X-cut crystal even though a smaller value of condenser would give greater oscillator output.

The condenser C_8 is required in order to provide a low impedance return to ground for the audio voltage. If a vibrator pack is used, the last filter condenser will probably be large enough to do the trick and no additional capacity will be needed. However with a dynamotor less filter is ordinarily used, and it may be necessary either to increase the size of the last filter condenser or hang an 8-μfd. midget electrolytic across it.

COIL DATA

All coils are wound of no. 14 wire, 1¼ in. diameter, spaced to approximately 1½ inches. Narrow celluloid strips are fastened to the oscillator coil with Duco cement to hold the turns firmly in place.

FREQUENCY	OSC. TURNS	AMP. TURNS
29.5 Mc.	15	8
37.1 Mc.	12	5

A corresponding intermediate number of turns may be used for a frequency between the two listed.

Test Transmissions From Naval Research Laboratory

A release from the navy department gives the following information concerning test transmissions to be made by it on the ultra-high frequencies. Although there is small chance that these transmissions will be heard in the western part of the United States, eastern listeners who are interested in u.h.f. work will do well to note the dates and times of the transmissions. The release follows:

"The navy department announced today that the Naval Research laboratory, Bellevue, D.C., will make test radio transmissions on ultra-high frequencies during the periods June 3 to June 18 and July 23 to August 6, 1938. The department is interested in the distance at which these transmissions may be heard and is requesting that persons observing these tests notify the Naval Research laboratory by mail or otherwise. Reports of failure to hear these transmissions are desired by the laboratory as well as reports of hearing them.

"These test transmissions will be made on the ultra-high frequencies 94.6 megacycles, 150 megacycles and 275 megacycles. The transmissions will be limited to the first and third fifteen minutes of each hour from 8:00 a.m. to 4:30 p.m. from Mondays to Fridays inclusive during both periods (June 3-18 and July 23-August 6) but will be continuous at other times between the dates given."

BETTER PHONE QUALITY

with Bass Suppression

By

J. N. A. HAWKINS, W6AAR

A really pleasant sounding phone rig on voice is rarely a matter of seventy-five dollar mikes, super-fidelity audio transformers or even 15 db of degenerative feedback, desirable though these things may be. This point is best demonstrated by listening to the average broadcast or police station, whose quality may be fine on music but usually doesn't sound as crisp, clean, smooth or as pleasant as it should on voice.

Personally, I don't care for any of the present day "high fidelity" ham phones on the air. My own choice, for swell quality, would go to W6CNE, W6ABF, W6BHO and W7FU of about five years ago. There were also several others in the east. Those signals were outstanding for reasons which I will attempt to explain.

We must start with the assumption that the rig is fairly free from harmonic distortion. The class-B input transformer must be big enough and properly designed. The class-B modulators must be running with some reserve power available and should be tubes with a minimum of negative resistance "wrinkles" in the positive grid characteristic, a point which has been greatly overlooked in some of the ultra-modern transmitting tubes.

The class-B drivers should be at least twice as big as they seemingly should be. Incidentally, while on this point of class-B drivers, four 45's in push-pull parallel are capable of much cleaner quality than a pair of 2A3's and require no provision for balancing the plate current as is usually necessary with 2A3's or 6A3's. 250's also make fine drivers, although they don't match up as well as 45's.

Forget all about phase-inverted push-pull audio stages unless you have access to a constant generator tone and a 'scope; even then the balance of the phase inverter should be readjusted occasionally. The amount of second harmonic that can be generated in the average phase inverter will be a great surprise to many of its advocates. Of course if lots of multi-stage degenerative feedback is used, phase inversion is not so bad; but feedback is not the cure-all that it may seem to be at 400 or 1000 cycles. It can add lots of fuzz above 5000 cycles and below 150 cycles.

Also I offer the heresy that push-pull stages are not what they are cracked up to be. In theory they are fine; but theory assumes that tube characteristics are always identical. In practice, the only tubes which seem to be really constant and similar in characteristics are the 45's and the WE205D's. I can see no real justification for push-pull stages until you are after more than 10 watts of audio. For anything less I would prefer a single-ended 45, 250, 300A, or even a 6L6 with feedback. Single-ended stages are easier to build and adjust, and modern core materials allow good low frequency response even with 60 ma. or so of d.c. flowing through the primary of the coupling transformer.

But the main thing is to forget about frequency response for the time being and get the harmonic fuzz out of the rig. Not one ham station in a hundred has a speaker that is good below 125 or above 4000 cycles, but you can sound like a million if your particular 125 to 4000 cycles is clean and smooth.

One very good way to kill two birds with one stone is to introduce what some call "dialogue equalization", but which I prefer to call "bass suppression", into your speech channel. First, you will get rid of the high powered lows which tie the class-B stage and its driver up in knots. Second, you will get rid of boominess that comes from the usually excessive low frequency reverberation in your shack. This room resonance often adds an extra 10 db to certain low frequencies, and aside from making your speech hard to understand, it sounds unnatural. Don't worry about sounding "sissy"; you'll still have lots of masculine growl left if it is properly done.

In figures 1 and 2 are shown two simple varieties of bass suppression. They are self-explanatory and can be placed between almost

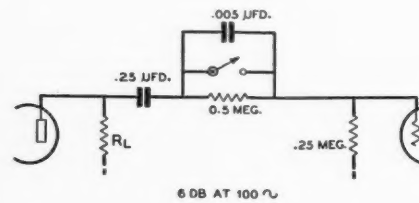
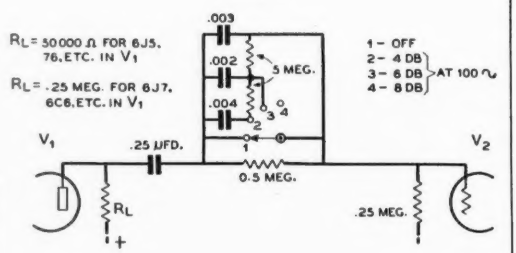


Figure 1

"Dialogue Equalizer"

Two Varieties of Bass Suppression

Figure 2



any two voltage amplifier tubes in your speech channel. They will work into or out of either triodes or pentodes, but *don't use feedback around the suppressor* or you'll suppress the suppression!

The bass suppressor is an old idea in the talking picture field and a few broadcasters are just discovering it. It is really surprising how much it cleans up the average boomy ham quality on voice. One reason the new "F" type telephone handset mikes sound so good on speech is that they cut off very sharply below 200 cycles.

The bass suppressor shown in figure 1 has a suppression of 6 db at 100 cycles while the arrangement of figure 2 has 0, 4, 6 and 8 db suppression in the four switch positions. The five megohm resistors merely eliminate the loud clicks which otherwise would be heard when varying the suppression.

In both of the arrangements the suppression starts at about 500 cycles although the good work really begins below 200 cycles. The 1000-cycle gain of an amplifier equipped with this type of bass suppression is practically unchanged with the suppressor in or out.

The *Varitone* method of equalization is highly effective for bass suppression but some playing around with the filter will be necessary, proper adjustment depending on the impedance to ground of the circuit in which you use it.

The next step is to correct some of the more obvious room deficiencies which affect most ham shacks, with their hard plaster walls and metal panels. Get some rock wool, monk's cloth, acoustic celotex or some such material. Unfortunately, most of the acoustic substances available absorb more highs than lows, while it should be the other way around. Anyway, spread what materials you can in front of you and try to talk *out* in to the room.

Next, hang the mike from a boom or cable and get it at least two feet away from your head. Mount it at least a foot higher than your head so you have to look up at it. This gives your throat, chest and diaphragm a break and improves your quality at least 100% before it even hits the speech amplifier. You'd be very surprised to know how haywire your quality goes when you hunch over a mike that it practically in your lap, particularly with a hard top table a few inches under the mike.

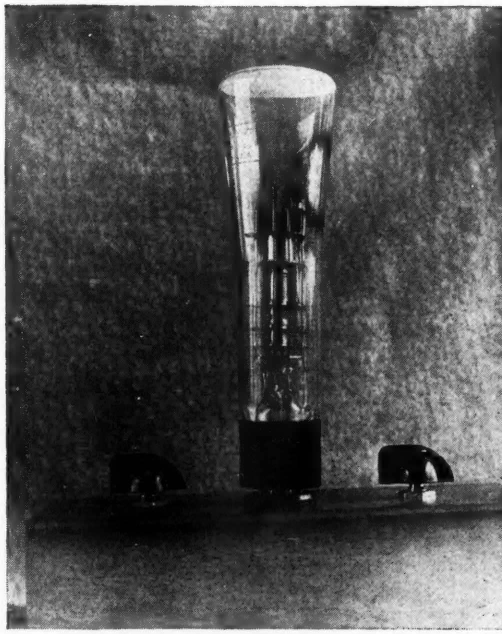
The quality that sounds most pleasing is what is termed "presence" by sound men, and consists of the right amount of high frequency reverberation. However, getting away from a mike also adds "boominess" or low frequency reverberation unless you experiment with mike placement. Open windows are ideal mediums of acoustic absorption as they offer equal loss to both lows and highs, and open doors also help if they open into a large room with some sound absorption of its own. Experiment with mike placement; try it here and try it there and get someone to read from a book while you monitor over the b.c.l. set in the front room.

A tip to those using crystal mikes: forget about the recommended 5-megohm grid leak in the pre-amplifier; experiment with from 50,000 to 500,000 ohms and watch the quality clear up.

Put meter jacks in the plate circuits of your supposed class-A voltage amplifier and driver stages to see if the plate current goes up and down with modulation. You may have a surprise in store if you think those stages are running class A. Bias them back down where they belong, get some voltage regulation into your plate power supplies and then go out and sound like Ted Husing.

Applications for the Cathode-Ray 'SCOPE

PART I



Last month we described simple oscilloscopes which can be built for next to nothing beyond the cost of the tube. We can now discuss some of the uses of this simple test instrument, beyond the familiar trapezoidal modulation pattern. Many such applications have been covered in Rider's book and in various articles, but few amateur owners of a scope seem to get around to making a broad study of the possibilities of the equipment. Some of the more commonly discussed uses are listed below:

- D.c. voltage or current measurements
- A.c., r.f., and peak voltage or current measurements
- Receiver trouble-shooting
- Adjusting i.f. stages including bandpass
- Measuring audio amplifier distortion, overload and gain
- Adjusting phase-inversion circuits
- Checking power supplies
- Checking harmonic content
- Measuring phase angle and phase distortion
- Drawing dynamic tube characteristic curves
- Checking phone signals and per cent modulation by:
  - Modulation envelope
  - Trapezoidal pattern
  - Cat's eye pattern
- Condenser power factor tests
- Over-all frequency response
- Determining unknown frequencies
- Adjusting auto vibrators
- Studying surges and transients

Orienting the Tube

If all is well, a cathode-ray tube will produce a small green spot close to the center of the fluorescent screen when both sets of deflecting plates are shorted. If a small battery voltage (45 volts or so) is placed between one pair of plates with the positive on the free plate and the negative on the high-voltage anode, the spot will jump toward the free plate. The movement will be greater for the plates nearest the base of the tube, which will become the vertical deflecting plates. In this way, it is possible to determine the internal layout of the deflecting plates. For similarity to algebraic nomenclature, there is some reason to turn the tube so that a positive potential on one free deflecting plate moves the spot upward, while on the other plate it moves the spot to the right. This puts the more sensitive plates which are next to the anode in a horizontal position where they can deflect the spot up and down, and are thereafter termed the "vertical *deflecting* plates." Ordinarily a sweep voltage is used on the other, less sensitive plates where plenty of voltage may be available.

With the tube in the above position, voltages will put the spot in the relative positions shown in figure 1. The x axis represents positioning due to voltages on the horizontal deflecting plates, while the y axis positions are determined by the potential on the vertical deflecting plates. Two volts positive on each free plate will put the spot in the relative position marked $x = +2$, $y = +2$.

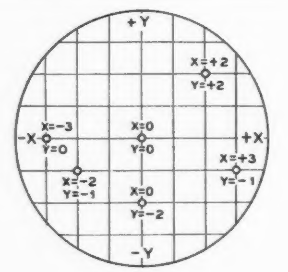


FIGURE 1.

Sensitivity

The sensitivity of cathode ray tubes—meaning the deflection of the beam caused by a given voltage—depends upon the voltage on the no. 2 anode. The deflection sensitivity ratings of the standard small tubes are given below:

		Anode Voltage	mm. per volt	volts per inch
Dumont 24XH (2 in.)				
	H	400	0.21	121
	V	400	0.23	110
	H	500	0.17	149
	V	500	0.19	134
	H	600	0.14	181
	V	600	0.16	159
R.C.A. 902 (2 in.)				
	H	400	0.28	91
	V	400	0.33	77
	H	600	0.19	134
	V	600	0.22	115
R.C.A. 913 (1 in.)				
	H	250	0.15	169
	V	250	0.21	129
	H	500	0.07	363
	V	500	0.10	254

A somewhat greater deflection (1.4 times) at an angle of approximately 45 degrees will be obtained by connecting the free plates together.

D. C. Measurements

Unless a calibrated meter is available, the oscilloscope is somewhat unreliable as a voltmeter. It does have the advantage, however, of not having a needle that might be bent around a pin if the voltage exceeds the meter rating, up to the maximum that the cathode-ray tube will handle, and of being a very high resistance instrument.

After determining the deflection of the spot for a measured d.c. voltage, the scope can be used as a d.c. voltmeter, with the help of a transparent rule (preferably decimal or metric ruled). To avoid burning the screen, a small a.c. voltage can be impressed on the otherwise unused horizontal deflecting plates, so that the deflection of a line, rather than of a spot, is measured. Figure 2 shows a double exposure of such a line, before and after the d.c. potential has been applied.

Current measurements can be made by determining the voltage developed across a resistor of known value placed in the circuit to be measured. D.c. measurements, of course, require a connection direct to the plates rather than through any blocking condensers that may be in the deflecting plate leads.

Action on Alternating Current

Before passing to a.c. and r.f. measurements, wherein the scope is more useful, let us study the effect of placing an alternating current on one pair of deflecting plates of the tube.

If the radius of a circle (OX) is swung around the circle, as in figure 3, and the length of the line XR plotted against the angle of rotation, in rectangular coördinates (X'Q), a *sine wave* is formed. If the radius is a loop of wire between two magnet pole pieces as drawn, it becomes a simple form of the a.c. generator supplying the house mains. When this voltage is placed on one pair of plates, with the other pair shorted, the cathode ray tube sees the sine wave "edge on" just as would be seen by an eye placed at R, looking toward Q. In short, the pattern is a straight line either along the x or the y axis of figure 1 depending upon the pair of plates on which the a.c. is impressed. The line is traced twice during a complete cycle. As is apparent from figure 3, the line follows the *peak* rather than the average or r.m.s. values of the voltage. The line will be weaker in the center than at the ends because the speed of the dot is greater at the center while it slows down and reverses itself near the ends.

Measuring A.C. or R.F.

This line can be used in measuring the voltage at audio or radio frequency. Of course, it

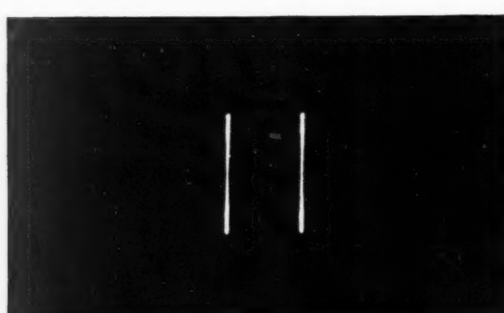


Figure 2. The deflection of a line or dot can be used in making d.c. measurements.

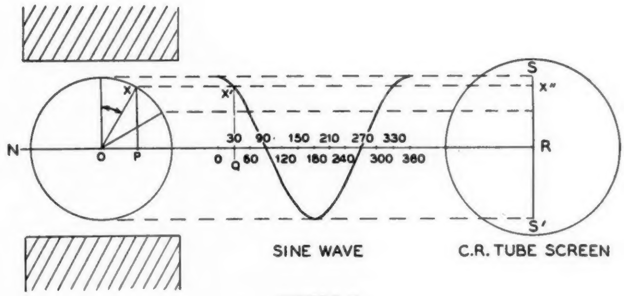


FIGURE 3.

extends from the positive to the negative peaks and only half of its length should be considered. If the voltage is a pure sine wave, the peak is 1.414 times the r.m.s. value as shown on a voltmeter. The scope can be calibrated with either an a.c. or a d.c. meter with proper consideration given to the above fact. If the deflection of the spot is one inch at 50 volts d.c., the line will be 2 x 1.414 or 2.828 inches long on 50 volts (r.m.s.) a.c. The spot would have moved only *one* inch if one pair of deflecting plates had been connected across a 50-volt battery.

Current measurements can be made by measuring the voltage across a known resistance in the circuit.

Radio frequency measurements can be made just as at 60 cycles whether the calibration has been made on a.c. or d.c. No amplifiers can be used in the scope unless the calibration is made at the frequency at which the voltage is to be measured, or unless the gain of the amplifier is known to be the same at the calibration and measurement frequencies.

While the scope properly measures the peak voltage, generally the resultant calculated r.m.s. value is correct only if the waveform is sinusoidal. On r.f. measurement, long leads may introduce an error.

Spurious Patterns

When both sets of plates are used, greater care is necessary to prevent distorted patterns due to a stray pick-up. If the free plate leads are long and connect to nothing, some kind of a small circular pattern usually results. In a few cases, the deflecting plate leads should be shielded with grounded flexible braid. If blocking condensers of different capacity or power factor are used in the leads, the pattern resulting from a.c. on both plates will not be the expected straight tilted line, but an ellipse. If apparatus that operates from the a.c. line is tested, it is often necessary to reverse the line plug or to ground things properly in order to avoid pattern distortion, particularly when the power supply has a condenser between the primary and secondary for hum elimination.

Phase Determination

After the pattern has been cleared of undesired effects, the scope can be used for phase angle measurement. Though this application may not be a common one, the theory behind it explains much of what is seen on the cathode-ray screen.

If identical voltages are applied to the two free plates by connecting them together, then the pattern is a straight line. That is, the voltage may reach a positive peak (let us say at the point $x = +3$, $y = +3$, in figure 1, assuming equal sensitivity) on each free plate at the same time. Likewise, the voltage will be zero ($x = 0$, $y = 0$) and at the negative peak ($x = -3$, $y = -3$) at the same times. The resulting line, as will be seen from plotting these points in figure 1, will run from the upper right to the lower left, with the tube oriented as described above. This indicates zero phase between the plates.

If the free plates had been connected to the opposite ends of a transformer, the line would go from upper left to lower right ($x = -3$, $y = +3$; $x = 0$, $y = 0$; $x = +3$, $y = -3$) because the positive peak would reach one free plate when the negative peak reaches the other, indicating a 180-degree phase relationship. The above tilts are opposite to those given by Rider, who apparently had his tube turned 90 degrees from the position described above, or used the outer plates for vertical deflection.

Now let us consider a 90- or 270-degree phase angle between the plates. This can be obtained by making the connections of figure 4. If the capacitive reactance of the condenser equals the resistance, at the frequency being considered, then the voltages will be equal. Formula for capacitive reactance is $X_c = 1/2\pi fC$,

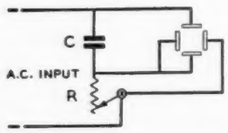


FIGURE 4.

Phase splitting circuit which gives an elliptical or circular pattern. C can be as much as 0.5 μfd.; R is a 50,000-ohm rheostat.

with f in cycles and C in farads. With an old 0.5-μfd. condenser on hand, a 50,000-ohm potentiometer worked satisfactorily, although with a better condenser, a smaller capacity will probably go with the potentiometer used. One precaution is not to use a condenser so large that the current through it will burn up the potentiometer at low resistance settings.

When the voltages are equal and 90 degrees out-of-phase, the peak of a half cycle on one set of plates occurs when the voltage on the other set is zero. That is, the spot passes through points $x = +3$, $y = 0$; $x = 0$, $y = -3$; $x = -3$, $y = 0$; and $x = 0$, $y = +3$, in figure 1. A circle therefore results. If the voltages are unequal, the pattern is an ellipse but its major axis is either horizontal or vertical. Figure 5 shows such a circle, with a waver in it indicating that the waveform is not pure.

If there is some other phase difference, the peak voltages of one wave occur neither with the peaks or zeros of the other, and a tilted ellipse results, as seen in figure 6. Phase differences of near zero (360 degrees) and 180 degrees give a very narrow ellipse closely approximating the tilted straight line.

Phase angles can be measured by calculation or by making comparisons with the shape of calculated ellipses. This is easily done. The voltage on the horizontal deflecting plates, alone, would cause the dot to spread out into the horizontal line HH' of figure 7. The voltage on the vertical deflecting plates alone would make the line VV'. If the phase difference is zero, then peak voltages occur together and the combined pattern would bring the line through the point C, the center, O, and the opposite corner. If the phase difference is 90 or 270 degrees, then the points where the ellipse touches the rectangle $VCH'V'H$, marked X and Y, are at H and V. Likewise it touches at H' and V' and the pattern is a circle (if the rectangle is a square) as explained above. The ratio of the distance CX to CH' gives the cosine of the phase angle, which can be determined without trigonometry by constructing the circle VV'.

This method is useful when the ellipse is almost a circle. When it is more narrow, then it is more accurate to use the ratio of the length OZ to OH' which is the sine of the phase angle, as seen in the lower circle, HH'. The above methods are useful regardless of the relative voltages on the plates. Calculated ellipses are given in figure 8, based on a tube orientation giving the zero phase line as indicated. The other orientation would give phase angles with the opposite tilt; whichever pertains to the scope at hand can be determined by connecting the free plates together and to the a.c. line, to determine which tilt results from the zero phase difference.

The above discussion of phase differences permits us at this point to mention a convenience for, rather than a use of, the scope. While a number of applications such as trapezoidal modulation patterns and tube characteristics require both sets of plates, some uses require plotting one voltage against time. In this case, the voltage to be tested is applied across the vertical deflecting plates while some sort of

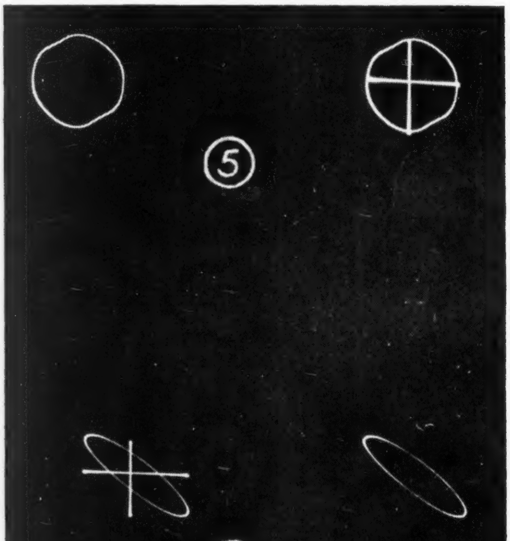


Figure 5. Circular pattern obtainable with phase-splitting circuit. The waver indicates an impure wave. The straight lines in the right hand pattern were obtained with additional exposures with the voltage on only one set of plates.

Figure 6. An out-of-phase voltage on the deflecting plates.

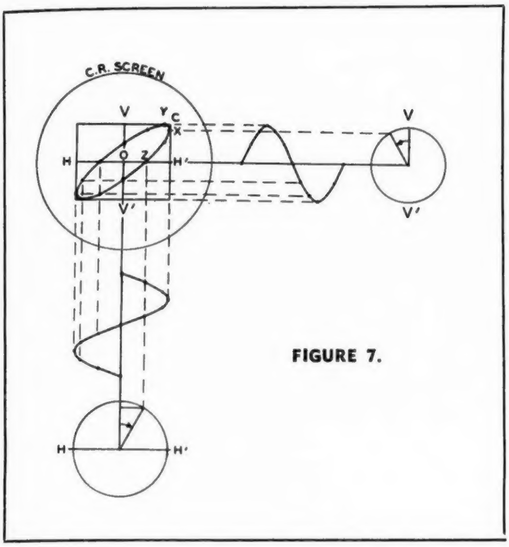


FIGURE 7.

voltage is put on the other set to "spread" the waveform applied to the vertical deflecting plates. While a saw-tooth oscillator is convenient for its ability to synchronize with the wave under observation and to give a constant rate of travel across the screen with a quick return, ordinary 60-cycle a.c. can often be used. One drawback to a "sweep" voltage that has a sine wave shape is that the going and returning traces are of equal intensity, putting two patterns on the screen on top of each other, one going each way. One of these lines can be eliminated.

If an out-of-phase voltage is applied to the intensity control, the spot brilliance can be increased for a half cycle and decreased during the other half. This can be done readily by inserting a resistor of a half megohm or a megohm in the connection between the intensity potentiometer rotor and the grid to which it ordinarily connects, and connecting a con-

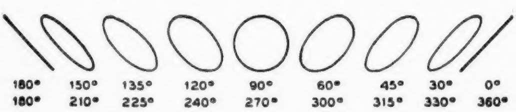


Figure 8. Out-of-phase ellipses for equal voltages on the plates.

denser between the free horizontal deflecting plate and the grid side of the resistor. This places an out-of-phase voltage from the sweep circuit on the grid, and suppresses the "return" sweep. The connections are shown in figure 9.

The resistor shown can be fixed, or a 1-megohm potentiometer can be used to provide some adjustment. The value of the condenser depends on the frequency of the return sweep voltage. At 60 cycles, 0.005 and 0.0025 have proved satisfactory, while Supreme Instruments Corp. uses 50 μμfd. though this appears to be more satisfactory for voice frequencies, using a saw-tooth sweep oscillator.

Figure 10 shows a circle formed by placing 60 cycles on both pairs of plates through a phase splitting circuit, and the same circle after the return sweep has been eliminated. In ordinary use, the sweep would give a horizontal

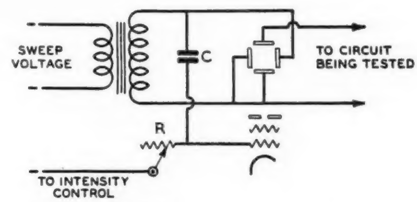


Figure 9. Connections for eliminating the return sweep trace. R is ½ to 1 megohm, fixed or variable.

line, and elimination of the return trace would not be apparent until some type of alternating voltage has been placed on the vertical deflecting plates.

Ordinary 60-cycle a.c. can make an inexpensive and fairly satisfactory sweep voltage for voice frequencies if the return trace is eliminated. It is improved if the voltage used is so high that the dot goes off the screen at both sides, leaving only the more linear center half of the sine-wave voltage on the screen itself, and if the observed wave can be adjusted to a frequency that is some multiple of 60 so that the pattern will remain stationary.

(All references to 60 cycles in the above discussion should be changed where the supply frequency is something else.)

(To be continued in an early issue.)

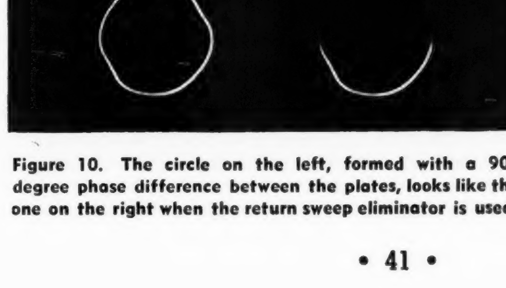
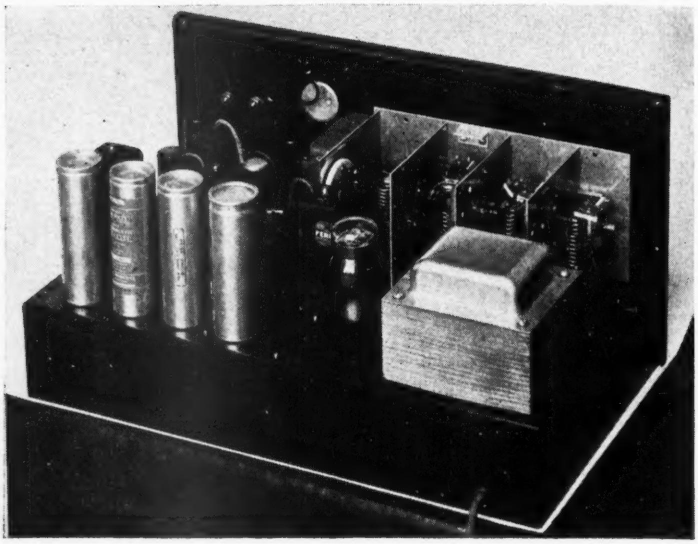


Figure 10. The circle on the left, formed with a 90-degree phase difference between the plates, looks like the one on the right when the return sweep eliminator is used.



Acorn-Tube FIVE-METER SUPERHET

By

ARNOLD J. ELY*

W8IPD

The receiver described herein was designed to provide the ultimate in ultra-high-frequency reception. It is probably *not* the ultimate, but the author believes that the higher the goal, the greater the achievement. Results indicate that every bit of time, effort, and expense expended was more than justified.

Poor signal-frequency gain is the outstanding deficiency of current u.h.f. receivers. Regardless of intermediate- and audio-frequency amplification, little can be done to improve signals which are "down in the mud" when tube noises account for 90% of the loudspeaker output. The conventional r.f. tube is poorly adapted for the u.h.f. amplification and seldom accomplishes more than isolation of the first detector from the antenna. It may even introduce a loss. Abundant signal-frequency amplification is therefore prerequisite in a good u.h.f. receiver.

The 956 acorn r.f. pentode will provide very substantial gain at 56 Mc. and is admirably adapted for the application. Accordingly, two 956's were used in tuned r.f. stages to insure adequate u.h.f. amplification. The entire receiver is built around the u.h.f. unit.

Mechanical Construction

The receiver is built in a 10"x17" cabinet. The u.h.f. unit is housed in an aluminum box 8½" long. The photo shows the unit with top and back removed. The tubes are mounted horizontally in the baffles, which are 4"x4", with an additional ½" bent under for mounting flanges. The baffles must be cut out for the condenser frames and shafts in order to fit against the front wall of the compartment.

The compartment nearest the condenser drive assembly contains the h.f. oscillator and first detector. The first i.f. transformer is mounted as close to the compartment as possible, to provide for a short detector plate lead which comes through a slot in the top of the wall. The i.f. section follows across to the other end of the receiver. The 6H6 second detector is behind the last i.f. transformer and is followed by two audio stages along the end of the chassis toward the panel.

The tube next to the drive assembly and closest to the panel is a dummy at present. Eventually this will be used in conjunction with the "R" meter after a suitable forward reading circuit has been designed. The tube between it and the i.f. section is the b.f. oscillator.

The tuning condensers are two dual midgets,

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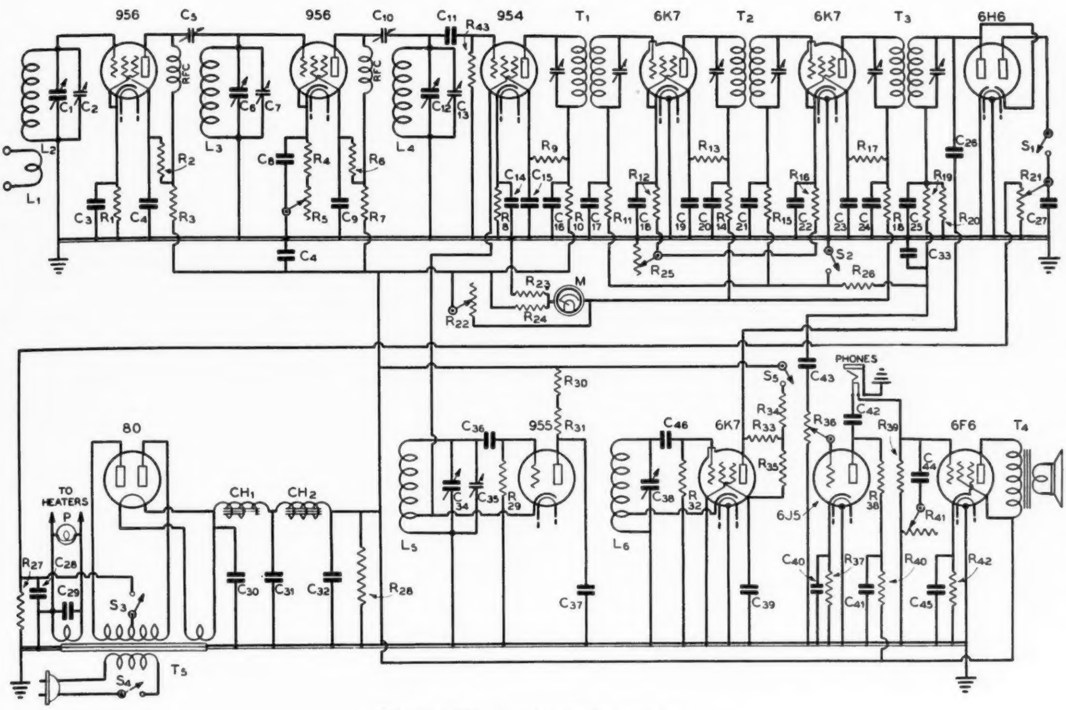


COMPLETE WIRING DIAGRAM

C_1—25-μμfd. midget condenser

C_2—3-30-μμfd. mica trimmer

C_3, C_4—.01-μfd. midget mica

C_5—3-30-μμfd. mica trimmer

C_6—25-μμfd. midget condenser

C_7—3-30-μμfd. mica trimmer

C_8, C_9—.01-μfd. midget mica

C_{10}—3-30-μμfd. mica trimmer

C_{11}—.0001-μfd. midget mica

C_{12}—25-μμfd. midget condenser

C_{13}—3-30-μμfd. mica trimmer

C_{14}, C_{15}—.01-μfd. midget mica

C_{16}, C_{17}—.05-μfd. 400-volt tubular

C_{18}—0.1-μfd. 400-volt tubular

C_{19}, C_{20}, C_{21}—.05-μfd. 400-volt

C_{22}—0.1-μfd. 400-volt tubular

C_{23}, C_{24}—.05-μfd. 400-volt tubular

C_{25}—.0005-μfd. midget mica

C_{26}—B.f.o. coupling (see text)

C_{27}—.25-μfd. 400-volt tubular

C_{28}—8-10-μfd. 50-450-volt elect.

C_{29}—0.1-μfd. 400-volt tubular

C_{30}, C_{31}, C_{32}—8-μfd. 450-volt elect.

C_{33}—.0005-μfd. midget mica

C_{34}—25-μμfd. midget condenser

C_{35}—3-30-μμfd. mica trimmer

C_{36}—.0001-μfd. midget mica

C_{37}—.0005-μfd. midget mica

C_{38}—B.f.o. tuning (see text)

C_{39}—.01-μfd. midget mica

C_{40}—10-μfd. 25-volt tubular

C_{41}—1.0-μfd. 400-volt tubular

C_{42}—.05-μfd. 400-volt tubular

C_{43}—.05-μfd. 400-volt tubular

C_{44}—.01-μfd. 400-volt tubular

C_{45}—10-μfd. 25-volt elect.

C_{46}—.0001-μfd. midget mica

R_1—1500 ohms, 1 watt

R_2—100,000 ohms, 1 watt

R_3—10,000 ohms, 1 watt

R_4—1500 ohms, 1 watt

R_5—10,000-ohm potentiometer

R_6—100,000 ohms, 1 watt

R_7—10,000 ohms, 1 watt

R_8—2000 ohms, 1 watt

R_9—500,000 ohms, 1 watt

R_{10}—15,000 ohms, 1 watt

R_{11}—100,000 ohms, 1 watt

R_{12}—500 ohms, 1 watt

R_{13}—100,000 ohms, 1 watt

R_{14}—10,000 ohms, 1 watt

R_{15}—100,000 ohms, 1 watt

R_{16}—500 ohms, 1 watt

R_{17}—100,000 ohms, 1 watt

R_{18}—10,000 ohms, 1 watt

R_{19}—50,000 ohms, 1 watt

R_{20}—500,000 ohms, 1 watt

R_{21}—50,000-ohm potentiometer

R_{22}—1000-ohm potentiometer

R_{23}—100,000 ohms, 1 watt

R_{24}—2000 ohms, 1 watt

R_{25}—15,000-ohm potentiometer

R_{26}—1.0 megohm, 1 watt

R_{27}—500 ohms, 10 watts

R_{28}—30,000 ohms, 10 watts

R_{29}—50,000 ohms, ½ watt

R_{30}—15,000 ohms, 1 watt

R_{31}—100,000 ohms, 1 watt

R_{32}—50,000 ohms, ½ watt

R_{33}—50,000 ohms, 1 watt

R_{34}—20,000 ohms, 1 watt

R_{35}—200,000 ohms, 1 watt

R_{36}—250,000-ohm potentiometer

R_{37}—2000 ohms, 1 watt

R_{38}—100,000 ohms, 1 watt

R_{39}—500,000 ohms, ½ watt

R_{40}—10,000 ohms, 1 watt

R_{41}—1.0-megohm potentiometer

R_{42}—400 ohms, 10 watts

R_{43}—1.0 megohm, ½ watt

Coils—See text

T_1, T_2, T_3—See text

T_4—6F6 output to voice coil

T_5—750 c.t., 80 ma.; 6.3 v., 3 a.; 5 v., 2 amps.

S_1—Noise silencer switch

S_2—A.v.c. on-off switch

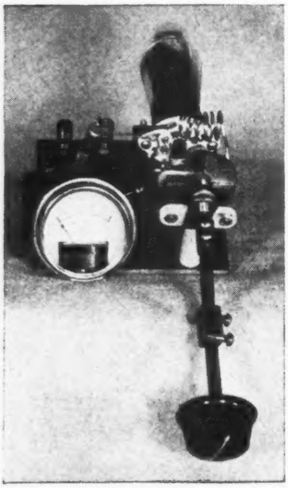
S_3—Communications switch

S_4—A.c. line switch

S_5—B.f. oscillator on-off switch

M—0-1 d.c. milliammeter

CH_1, CH_2—20-hy. 75-ma. chokes



The 56-Mc. oscillator used in aligning the receiver.

25 μμfd. per section, with isolantite supports. The particular ones used were chosen because their construction was best adapted to the layout and space, which was intentionally limited to make short leads possible. The tuning range covers considerable territory on either side of the 56-Mc. band. If desired, several plates may easily be removed to decrease the tuning range, but in any case the maximum capacity per section should not be reduced below 15 μμfd.

The condensers are mounted on the front wall of the compartment at the proper height to couple to the drive assembly. A piece of 5/16" square brass 8½" long was screwed to the chassis and the wall bolted to it, providing a very substantial support for the condenser gang.

It is suggested that the baffle mounting screws be tapped into the flanges and inserted fr ›n below the chassis since the parts on the baffles make the screw holes inaccessible from above. The rear wall is fastened to the chassis by two angles and the top is fastened by angles on the front and rear walls.

Acorn Sockets

Originally, metal sockets with built-in by-passes were used. It later developed that in several cases the clips shorted to the metal plates, causing no end of trouble which was exceedingly difficult to locate. So these sockets were discarded. The oscillator socket is isolantite, but the r.f. and first-detector sockets are bakelite, homemade with the clips furnished with the acorn tubes. It probably would have been advisable to have made the sockets from victron or some other insulating material that would be better than bakelite at u.h.f. However, no serious losses are introduced by the bakelite as the grid and plate leads of the pentodes are in the ends of the envelope and do not come into contact with the socket. The sockets are very easily constructed from dimensions and angles given on the technical data sheets. The clips were mounted on the bakelite base by means of the small self-tapping screws furnished with Crowe name plates. They turn very nicely into no. 45 drill holes.

The baffles are from 2⅛" to 2⅜" apart. The spacing is dictated by the distance between condensers and the convenience with which the baffles may be made to fit into the proper positions. Due to close spacing between baffles, it is necessary to stagger the elevation of alternate tubes above the chassis.

After mounting the sockets, a brass screw was run through each baffle at as central a point as possible to provide a common ground for all leads, by-passes, and a grid return from the opposite side. All leads were left about five inches long, cabled, and anchored to the baffle by cable clamps. When mounting the baffle, the cable is run through a hole in the chassis close to the flange and the leads are soldered to terminal strips underneath. Individual baffles are therefore easily removable for alterations. By-passes, cathode resistors, and grid leaks were mounted on the sockets, but voltage-dropping resistors and decoupling networks were mounted on terminal strips underneath the chassis, thereby facilitating voltage adjustments. A separate ground lead is included in the cable for each baffle.

The coupling and padding condensers are all 35-μμfd. isolantite-mounted compression-type trimmers. These are supported on their leads which are of no. 14 bare copper wire and which should be made as short as possible.

The top of the compartment is provided with holes directly above each padding and coupling condenser, permitting adjustment with the entire unit assembled.

Coils

L_1, the antenna coil, consists of 6 turns of no. 14 bare copper wire, 11/16" long and ½-inch in diameter. L_2, L_3, L_4 and L_5, the tuning inductances for the r.f. stage and the oscillator, consist of 8 turns, same wire and diameter, 1 inch long. L_5 is tapped two turns from ground for the cathode tap of the 955 h.f.

oscillator. These coils are mounted directly on the tuning condensers, the leads should be as short as possible, and the coils should be placed as near as possible to the center of their respective compartments.

The r.f. chokes were commercially made, but homemade ones for this frequency should perform equally satisfactorily.

If each baffle is wired and mounted with its associated inductance, starting with the one next to the drive assembly, no difficulty should be experienced in assembling the high frequency unit.

I.F., Second Detector, A.V.C.

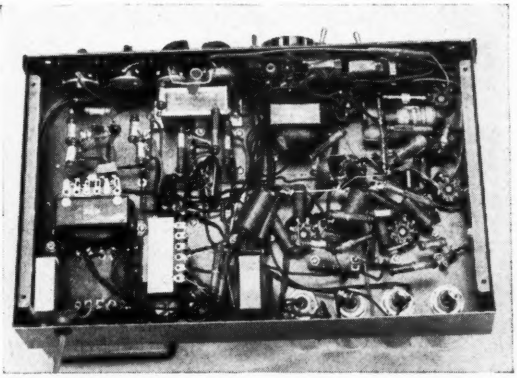
T_1, T_2, and T_3 are 3000-kc. iron-core i.f. transformers. The i.f. section is conventional and feeds into one diode of the 6H6 second detector, which also provides a.v.c. to the intermediate amplifier. The "R" meter is in the plate circuit of the i.f. amplifier and is actuated by changes in the plate current due to signal-variation of the a.v.c. It is backward reading and it is suggested that it be mounted upside down to indicate increased signal as the pointer moves from left to right. Or, a forward reading "R" meter as suggested by Higgy (RADIO, Oct., 1937) might be substituted.

Noise Silencing

The other 6H6 diode acts as a noise limiter in a modification of the Watzel circuit. Two systems were tried, the one shown proving to be superior. It does not entirely eliminate ignition interference but the silencer does reduce it to a level which more than justifies its inclusion. Silencer operating voltage is secured by the drop in the 500-ohm resistor between the power transformer center tap and ground. This voltage is varied by the 50,000-ohm potentiometer which shunts the resistor. The control is mounted beneath the "R" meter on the panel and the on-off switch for it is a part of the control.

High-Frequency Oscillator

The high-frequency oscillator is of the grounded-plate Hartley type. Both grid and cathode coupling were tried. A slight amount of instability was experienced with grid coupling and inasmuch as cathode coupling corrected this fault and was otherwise quite satisfactory, the choice was inevitable. The cathode tap was made two turns above ground. The tap position does not seem to be too critical, but it may be necessary to vary it to obtain peak performance.



Under-chassis view. It will be noted that four filter chokes are employed whereas only two are shown in the wiring diagram. These were required because the local line supply was 25 cycles; they will not be needed under ordinary conditions.

Beat-Frequency Oscillator

L_6 is the b.f.o. coil. It consists of $1\frac{1}{4}$ inches of no. 30 enameled wire on a $\frac{1}{2}$-inch wooden dowel, tapped $\frac{1}{4}$ inch from ground. This unit was made from the parts of a broadcast i.f. transformer. The compression-type tuning condenser, grid-coupling condenser, and grid leak were mounted inside the can, which was wrinkle finished to match the i.f. transformers. Coupling to the detector input diode was through the small capacity of one turn of insulated wire around the diode lead. Coupling should be varied until it is possible to heterodyne signals of various levels satisfactorily. Since taking the photograph, it was found necessary to shield the b.f.o. grid lead and to place a metal cap over the tube, as its output was getting into the i.f. section through the i.f. grid leads.

T_4 is a universal output transformer which will couple to any voice coil. A permanent-magnet dynamic speaker was used in our case. The transformer is mounted underneath the chassis.

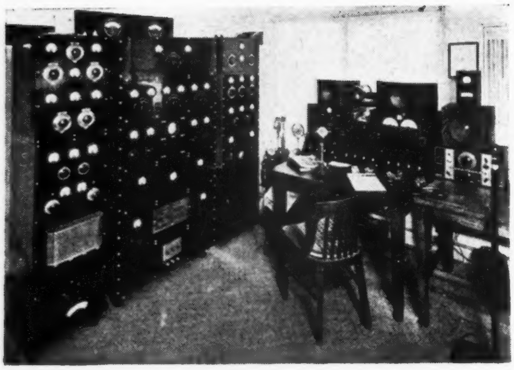
It will be noted that every stage is decoupled by a 10,000- or 15,000-ohm resistor. This may or may not be necessary in all cases. The power transformer supplied more voltage than was required and the excess was utilized in decoupling and providing noise-silencer operating voltage.

Although a front-panel view is not shown, the panel controls are, from left to right: r.f. gain control and primary switch, i.f. gain, a.f. gain, tone control, stand-by switch, a.v.c. switch,

[*Continued on Page 77*]

56 Mc. Dx Rampant!

By E. H. CONKLIN*



This is W4EDD in Coral Gables, Florida, perhaps more widely known on 28-Mc. phone. The 56-Mc. receivers do not appear in the photo.

All districts participated in the five-meter dx in May! Two stations have already worked seven districts. To mention some of the high spots, W6's worked W7's on the 12th; W4EDD worked all northeastern districts on the 15th; W5EHM made 28 contacts with W3-W8-W9 on the 19th; W9's worked W2 and W3 stations on the 27th; W5EHM raised gobs of W8 and W9 stations on May 30, 31, and June 1. By the end of the month, everybody seemed to be working everybody else. We have tried to collect both sides of the story for the earlier days in May and at least some of the news for the later ones.

May 12

The first day on which numerous contacts were made, as far as has been reported to us, was May 12. Some of this story was carried last month in Herb Becker's dx department. Eldred W. Start, W7AQJ, of Vancouver, Wash., said that the first symptom was short skip on ten meters after 5 p.m. Pacific time, sixth district stations coming through with very good signal strength, so he switched to 56 Mc. at six o'clock. In ten minutes the first contact was made with W6IOJ in Hollywood whose i.c.w. was a steady R7 to 8. Next he was called by W6MKS in San Diego who got W6DNS in on a three-way, phone and i.c.w., until 6:38. He was then being called by W6AVR in Colton, Calif., whose phone was fading from R9 to 7. At 6:55 W6IOJ was again raised.

During this time, W7ABZ, W7FQV and W7AKY of Portland had come on the air when the sixth district seemed to be fading out. Five minutes later the signals were back and W7AQJ spent nearly an hour getting the Portland gang back on the air. W7ERA joined in on the dx. W7AJQ had another contact with W6AVR at 8:15, finding the signals still strong both ways. W6IOJ had in the meantime worked W7ABZ but could not raise the others. Contacts continued between the W6's and W7's who were on the air, until 9:15 when things were interrupted in Portland by a call from a K7AMM who doesn't seem to be licensed. At 9:20, W6GZE in San Francisco called W7AQJ with an R7 to 8 signal. W6AVR confirmed the Portland observation that the band had been fading out in cycles of approximately thirty minutes with a complete recovery each time. W7AQJ heard W6HDY, W6KFE and W6VQ, receiving cards from W6MQQ and W6OJU.

Start says that he used a three-tube superregenerative receiver with type 76 tubes, built six years ago. The transmitter uses a self-excited pair of 45's with 20 watts input, modulated by a single 45. The receiving antenna was a horizontal wire, while the transmitting antenna was a half-wave doublet with a parasitic reflector aimed roughly southwest.

The ultra-high-frequency end of station W2JCY in North Pelham, N. Y. 250-watt and 1-kilowatt transmitters can be seen in the background. Reading from left to right are Lt. W. A. Freeman, W8NR; RM1C Merritt Kirchoff; Lt. Commander L. M. Cockaday, W2JCY.

*Associate Editor, RADIO.

All districts participate in five-meter dx in May! Two stations work seven districts. By the end of the month, everyone seems to have been working everyone else.

May 15

The honors for Sunday, May 15, go to H. H. Robinson, W4EDD, of Coral Gables, Fla. Robbie worked W5EHM crossband last year, and made definite plans for dx attempts this summer. He put up a 5-element Yagi array "a la W2BMK" with three directors and one reflector all spaced 1/4 wavelength, the antenna fed with a concentric line, and tested several receivers. Larry Cockaday, W2JCY, and Frank Lester, W2AMJ, kept after him to start the schedule. Because Frank was going to pull down his equipment shortly, a test was arranged for 1 p.m. Eastern time Sunday, May 15, with fifteen-minute transmitting and listening periods. This was confirmed on 28-Mc. phone after W1KNM and W2HWX passed the details on to the first and third districts.

At one o'clock Eastern time nothing was heard, but at 1:15 in came W4EDD giving a list of stations heard in the preceding 15 minutes. It was apparent that somebody had his clock or the schedule wrong, but there would have been bedlam anyway. W2JCY says that a hundred stations could be heard calling W4EDD during the transmitting periods, while Robbie found the band so wide open and so many stations calling that QRM was terrific. Using a resistance-coupled-i.f. superheterodyne, Robbie could only take the loudest stations. He remarked that sharp i.f. stages, even if only the stabilized stations could be copied, were necessary with interference like that.

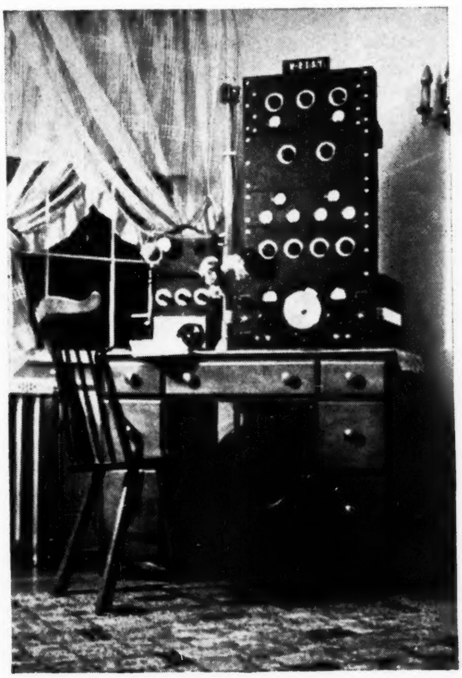
During the listening periods the following were logged at W4EDD with R6 or louder signals: W1IXP, New London, Conn.; W2ISY, Bogota, N. J.; W2GZC, New York City; W3GMZ, Washington, D. C.; W3EZM, Langhorne, Pa.; W3GGC, Philadelphia; W2AMJ, Bergenfield, N. J.; W3CMA (incorrect call—not issued); W3FOM (not on air; incorrect call); W3HKN, Washington, and W3GOK (not on 56 Mc.; incorrect call).

Robbie stuck to the schedule though plenty of the boys worried for fear that the band would close down before contacts were made. W2JCY on 58 Mc., with 250-watts crystal controlled, told W4EDD that he won the Stetson hat for the first QSO with that district—there remaining only two such offers for the first W6 and W7 stations to work W2JCY, the only remaining unworked districts!

Robbie told Larry about his R9 signals, but completed a series of about five transmissions with W2CUZ testing antennas. Robbie found no difference between horizontal and vertical polarization, but W2CUZ thought that a horizontal flat-top gave somewhat better signals and less fading than a vertical "J". W2JCY was next worked. Some of his log reads as follows:

"(W4EDD finishing with W2CUZ) 'Well, this is fine. I want to have a complete two-way QSO with Larry; I think he owes me a brand new Stetson hat! Larry's signal is tremendous here. Well, so long, Don, this has been fine and I hope we can do it again. I'm going over to Larry now. W2JCY, this is W4EDD listening for you now Larry. Come in.'

"W2JCY called W4EDD but could not log what was said. Three transmissions. W4EDD answered as follows: 'W2JCY, W4EDD Coral Gables calling and coming back. O.K., Larry, this is certainly fine and better than ten meters. Little did I think when I talked to you on "ten" this morning making the final arrangements that it was going to be this good. I'm never going back to ten! This is fine. I heard you repeating over and over about the telegram and report. . . . I have never been so pleased. Boy, am I pleased. When I first heard you, you were R7 but you have been R9 plus with some QSB



The receiving position at W2ISY.

W2ISY's Mobile Rig.

but all O.K. Yes, I heard Frank (W2AMJ). I will be glad to listen for him. Go ahead, Larry.'

"W2JCY thanked W4EDD for the test and wanted to sign to give the others a chance. W4EDD answered again: 'O.K., Larry. I am glad you have all the transmissions logged. You were on the loudspeaker all the time; could hear you all over the building. Will sign with you now and listen for Frank. Good luck. Will write you tomorrow and will send all stations heard QSL cards. So long, Larry, will see you later.'

"W4EDD contacted W2AMJ at 2:25 Eastern time. At 2:40, he contacted W8CIR in Pittsburgh then W8NED, very short, saying, 'W8NED, you came in O.K. but faded out.' W2CUZ called W4EDD again and tested with him, W4EDD answering, 'Please get a message to Frank and tell him that the receiving was done on his Lafayette acorn receiver. I have 150-watts input into antenna, same type as I use on ten meters. All signals come in just the same with either vertical or a horizontal antenna. My antenna is 30 feet above a two-story building.' W2CUZ made a very long transmission testing on a vertical antenna and on a horizontal beam. W4EDD could hear both about the same; this not logged carefully because of interest in results; could not notice much difference on either a vertical or a horizontal except that when one was best, the other was weakest, in pick-up. The results indicate that this was a real reflection because if it were not, the receiving station would have to use the same polarization as the transmitter to get the best reception.

"At 3:10 there was QRM on W4EDD after which he said, 'It sure doesn't seem to make much difference how much power you fellows use; one of the stations I heard was using only 30 watts. Power doesn't seem to mean much. I will now listen for W1EYM so you can sign off. 73.'

"W4EDD then called W1EYM but didn't QSO until W2JCY called and said he was on 56.64 Mc. after which W4EDD thanked W2JCY for the frequency and came back to W1EYM as follows: 'W4EDD coming back to W1EYM. O.K. and R6. Some of those second district stations are putting in terrific signals here and causing me QRM. This is my farthest dx on five meters so far today.'

"Meanwhile, at least a hundred New York stations were calling W4EDD wildly. W4EDD continued, 'W4EDD calling W2ISY. I heard you calling me but QRM is terrific now. You were R8 to 9. I hope that I am doing as good.' W2ISY didn't come back until W2JCY relayed the call. W4EDD continued: 'W4EDD calling W2ISY. I heard your first call and answered you but did not hear you come back. So long, O.M. I also heard W2BHD. What say, W2BHD?'

"Following QRM, W4EDD was heard to say: 'Not very strong here now. I've heard about 30 to 35 stations but too much QRM now. I was trying to get W1EYM through. I got a report from him. I'm trying to do the best I can to answer all the boys I hear calling me. I will turn it back to you. I appreciate this contact on five meters. W4EDD off to W2BHD . . . W4EDD back for a final with W2BHD. Will send you my QSL card. Sorry that I could not work everybody. 73 and best of dx.' W4EDD then gave a few more calls but began to fade very rapidly until 3:58 when his voice was too weak and we switched on the beat-frequency oscillator. His heterodyne ceased at 4:08, standard time."

The whole rig at W9CQV in Chicago, who worked W5EHM on the 19th. In the center is the T20 long line oscillator, with the superregenerative receiver on the right. Before this, the W8CVQ card was the proud dx.

Frank Lester, W2AMJ, said that gloom was heavy because of the lack of success with W9 tests after dx in previous years. May 15 was a rainy day, as it was in Florida, keeping many of the fellows home. On tuning his receiver, Frank heard a voice like Robbie's, but passed it up until he heard the list of stations received and knew it to be the test transmission. The signals were hitting R9 plus on peaks on the

R meter in his SX17 receiver, which was being used in conjunction with a tuned 954 r.f. stage plus a little fixed regeneration. As at W2JCY, the signals faded out around 4:08 but they lasted until around 4:30 at W1EYM and in Ohio.

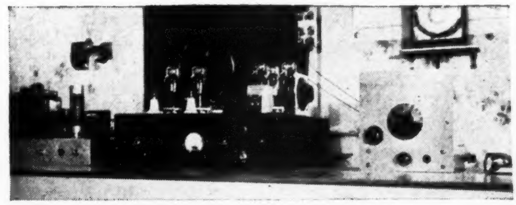
W2HWX made his contact with W4EDD at about 2:15. His present transmitter is a band-switch job for 14, 28 and 56 Mc., completely enclosed in a 42-inch par-metal cabinet with speech amplifier and all power supplies. The final uses a pair of 35T's with 400-watts input. The receiver is an Ultraskyrider with a two-stage preselector using 956 acorn tubes on 56 Mc. only. The antenna is four-in-phase arrangement in a diamond shape, with five reflectors, motor driven.

W3GMZ in Washington received a confirmation for 1:15 to 1:30, but he heard two complete transmissions and copied the key numbers C-155 and C-156. The transmitter is crystal controlled on 57,240 kc. with 135 watts on a pair of T55's in the final. The antenna is a Q-fed horizontal. A resistance coupled i.f. superheterodyne is used.

Up near Pittsburgh, W8CIR has been doing a lot of good dx work. He heard W4EDD from about 2 to 5 p.m. on the 15th using a seven-tube superheterodyne. His transmitter, with 250 watts on 56,130 kc., puts one of the best eighth district signals into Florida, with the help of a Yagi array only 20 feet high, using three directors and three reflectors. This generally gets 2 to 5 R's better reports than a Q-fed dipole 80 feet high.

W8NED in Pittsburgh was another of the stations able to work W4EDD. He said that almost everyone heard Robbie, even one station located in a narrow valley which has difficulty working locally. W4EDD came through

Frank C. South, W3AIR, Princeton, N. J.



W1KTV, the station of George Newick in Portsmouth, New Hampshire.

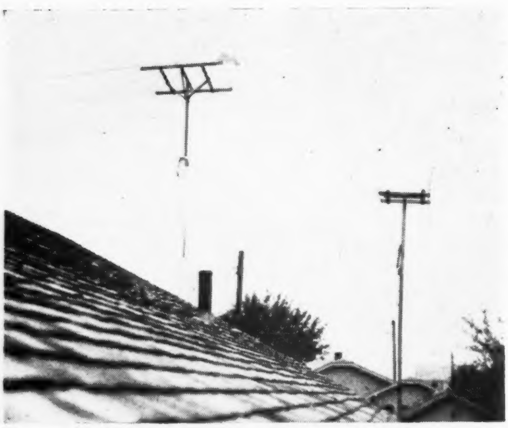
from 2 to 4:15 while at 2:50 a W5 also was heard, very weak but not identified.

Up in Connecticut, W1EYM heard Robbie promptly at 1:15 on schedule, R9 plus, coming in best on a Q-fed vertical 60 feet high—but when he faded down, the strength could be brought back on a horizontal 20 feet high. The receiver used a converter with a 954 r.f. stage, a 954 detector and a 955 oscillator, working into a Hammarlund Super Pro. The QSO at 3:24 p.m. was made on a crystal controlled transmitter with 70 watts on a pair of 6L6's in the final, modulated with 6L6's. The only other dx that came through during the afternoon was semi-local—W3EZM and W2HWX.

W3EZM, in Langhorne, Pa., says that Robbie was coming through with typical 28-Mc. fading from about 1 to 4 p.m., with almost everybody on the band also hearing him. Newbold has no less than twelve tubes in his superheterodyne with acorn r.f., 2-Mc. untuned i.f., noise silencer, and all the works. The transmitter on 58.32 Mc. has 150 watts on a pair of 808's feeding either of two 5/8-wavelength vertical antennas through a coaxial cable. The antenna is 70 feet above ground, putting it 290 feet above sea level.

About the time of the schedule, W2ISY decided to straighten out his antenna system, then to listen to a b.c.l. program. At 1:45 when the SX17 and single stage regenerative preselector were fixed up on "five", every audible crystal controlled transmitter was calling W4EDD! When he did come through, it was so loud that Ross checked the band switch because it sounded like his usual 28-Mc. signal. The 400-watt transmitter brought an R9 plus report when the contact was made at 3:20.

Herb Baasch, W2BHD, was one of the last to make a contact. He was using 120 watts on a pair of 35T's in the final, driven by 802's. The antenna was a 66-foot center-fed Hertz located 25 feet above the apartment roof, and running north and south. The receiver was built originally for 40 and 20, using two 6D6 preselection stages, 6C6 detector, 6C6 second



The 56- and 28-Mc. rotary beams at W5ALK in Fort Worth, Texas.

harmonic oscillator, two stages of 500-kc. i.f., 6B7 second detector and 42 audio. The regeneration in the first r.f. stage accounts for a lot of the gain.

Other Dx Reports

Within ten days, W4EDD had received some 125 cards from various points from Connecticut to Ohio. Most of those whose signals got into Florida were also hearing Robbie. W8KG/W8YC in Akron listened to most of the QSO's but didn't make contact. W8MST in Arnold, Pa., some eighteen miles north of Pittsburgh, followed most of the work, using a four-tube resistance coupled superheterodyne and a vertical J antenna, concentric line fed. W8RSS heard an unidentified W2 but didn't hear W4EDD although other Cincinnati stations heard and worked him. W9WLX in Ft. Thomas, Ky., is another greater Cincinnati station reporting W4EDD. W8PTG in Springfield, Ohio, heard W4EDD weak and fading at 2:50 during the contact with W8NED, although another listener there had reported Robbie R9 a little earlier. W2GZC heard the dx only for about two minutes at two o'clock.

W8VO in Akron heard W4EDD all afternoon, W5EHM around 1:00 p.m., and W2EHV around 4:00 p.m. W8KAY also heard W4EDD. Several stations around Cuyahoga Falls, Ohio, heard him.

W2KXH at West Orange, N. J., advised his wife not to waste her time listening for the test transmissions. Soon, she let out a shriek when she heard the transmissions start.

In Dallas, W5EHM heard weak carriers from 3 to 7:45 Eastern time, then a harmonic from W4EEV in Atlanta. The latter uses a kilowatt on 28 Mc. and has since put R9 signals into Dallas on "five".

W4EDD's Rig

The transmitter at W4EDD uses a pair of 809's (what, that little tube?) with 150 to 175 watts input. The horizontal Yagi antenna has already been described. The receiver was a six-tube superheterodyne with resistance-coupled i.f. stages. Sharper receiver selectivity, even if unstable signals will be sacrificed, will be absolutely necessary for this type of dx when hundreds of signals come through at once. An RME 510X expander has already been received, allowing a selective receiver to be used in a triple-detection arrangement.

May 19

Up in Milwaukee, W9ANA has been running an automatically keyed 500-cycle r.a.c. rig on 56,936 kc., with 250 watts on a pair of 50T's in the final, driven by T20's. At 8:16 a.m. Central time on May 19, he was heard by W5ALK in Fort Worth, Texas. At 10:08 a.m., W1KTV in Portsmouth, N. H., logged him for about ten minutes. During the Radio Club meeting that night, W5EHM also heard him. At 1:45 p.m., Eastern time, W8CVQ heard two dx stations on 58 and 59 Mc. sending five letter and number code groups to each other, but they faded out.

While there was a lot of dx work done during the evening, the most remarkable was that of J. C. Patterson, W5EHM, of Dallas who put his contest experience to work and smoothly went through twenty-eight QSO's in an hour and forty minutes, some as close together as one minute. He had enough time to test receivers and antennas, and to check the 28-Mc. band to find that it was open in the same direction at the same distance. Between 6:50 and 8:30 p.m. Central time, he made the following contacts, almost the entire list having been confirmed to us directly: W8OQJ, W8RSS, W8PEJ, W8KG, W8EUK, W3GMZ, W8KAY, W9CLH, W8JMS, W8QDU, W8CIR, W8YUT, W9WLX, W9CQV, W9FP, W9YFQ, W9AAV, W9TZQ, W9OCW (also reported as W9OPW on May 27), W9VJO, W9SQE, W9ARN, W9ZGD, W9ZEO, W8PNU.

His earlier list also mentioned working W9MPV in Milwaukee (W9ANA confirms this contact) and W8FMI (who moved from

his Cincinnati address), these calls being overheard by W9TZQ. Calls heard included W3GOD (incorrect call or a bootlegger with an ego), W8NSS and W9ANA.

The first QSO was with W8OQJ in Cuyahoga Falls, Ohio, at 6:50 p.m. Central time, who said that W5EHM was heard until 8:15 p.m. The receiver is a resistance-coupled superheterodyne, the transmitter crystal controlled with 20 watts on a single 6L6 final. The antenna is a vertical doublet some 30 feet high.

In Cincinnati, W8RSS was working a weak local when he was interrupted by someone fading in calling "CQ DX". In some disgust, W8RSS waited for the sign which gave him a terrific jolt when it was W5EHM. This was at 7:10 p.m. Central time, the signal lasting until 8:50. Two or three other fifth district stations were also heard but their calls were not definitely logged. W8RSS runs about 60 watts crystal control, using a vertical antenna 35 feet high. The receiver is the usual for the Cincinnati area, a resistance-coupled superheterodyne.

Next was W8PEJ in Ingomar, Pa., about ten miles north of Pittsburgh. He had been hearing Pat since 6:55 Central time, working him at 7:05 and listening until he passed out at 8:15. During this time a W4 was heard but fast fade and storm static prevented identification. A single 6L6 with 30 watts input, resistance coupled superheterodyne, and a Q-fed vertical 40 feet high, were used.

In Akron, W8KG/W8YC heard Pat from ' to 8:20 Central time, working him at 7:15. W5E? (possibly W5EEX in Houston) on 56.5 Mc. was heard in the QRM. Several other weak stations were also coming through. The transmitter was a single 6L6 final with only 11.5 watts input to the plate and screen, getting an R7 to 8 report! The receiver was an SX16 Superskyrider with the r.f. stage cut out by connecting the antenna to the 1st detector grid. On 56 Mc., this has doubled or tripled the signal strength in the several sets on which it was tried.

Pat went right after W3GMZ in Washington, D. C. W5EHM was R4 to 9, slow fading, often louder than many locals. W3GMZ's rig was described under the Florida dx of May 15.

After providing a good dx signal last year, W9CLH has heard some of the dx, and worked W5EHM twice on the 19th, as well as W5EEX in Houston at 8:30 Central time. The crystal controlled rig at W9CLH puts about a half kilowatt on a pair of HK354's using a short condenser-tuned line running above the rack, as a tank circuit; this rig usually brings an R9 report from the dx! The antenna now is a vertical four-section flat-top pointed east or a little north of east, for working Chicago and W8CVQ. Both an Ultraskyrider and an RME with the 510X expander are used for receiving.

On the 19th, W8QDU drove out to a hill near Pontiac to try for W8CVQ with a mobile rig. He heard W5EHM making a few contacts and dragged down a QSO for himself. The signals lasted until 8:20 Central time, fading all the while. An acorn superregenerative receiver was used, being interferred with by static discharges. Detroit stations faded down until W5EHM had gone out for some twenty minutes. W8QDU mobile uses 15 watts into a crystal controlled RK34 on 56,016 kc., feeding a ¾-wave vertical through a concentric line. At the home location, 250 to 350 watts on a pair of 35T's on 56,060 and 57,030 are used, the receiver there being a revamped Ultraskyrider with a two-stage acorn-tube preselector.

W8CIR didn't miss this dx either. He worked W5EHM with R9 signals both ways using the 80-foot-high vertical, and R14, according to W5EHM's R meter, using the Yagi!

[*Continued on Page 78*]

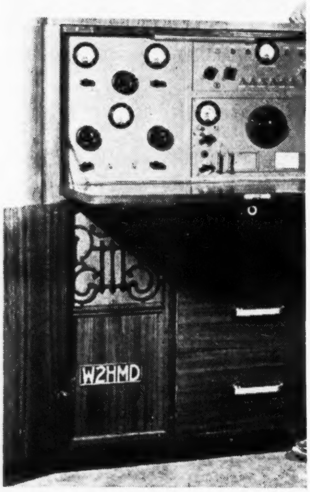
Max Fisher, W5ALK, who heard plenty of the dx going on May 19th.

STREAMLINED

is the Word

By

FRANK FRIMERMAN, W2FZ



When George Korper, Jr., W2HMD, finally decided to forego single blessedness, Mrs. Korper, Junior, succeeded where for many years Mrs. Korper, Senior, had lamentably failed. "This radio junk," the interdict read, "must be Gone With the Wind, and so forth; in plain English, either hide it or put it out!"

So we hid it. While not a new one, the problem of how to reconcile the ham station with the interior décor of a Manhattan cliff-dwelling has been solved here with particular elegance, so we think. The physical space available consisted solely of a mahogany "secretary", outside dimensions 47"x34½"x14", inside dimensions slightly less. Into about half a cubic yard of volume it was desired to stow away a medium-powered phone rig complete with modulator, power supplies, superhet receiver, space for log-book, extra coils, etc., and, as a concession to the lady of the house, a phonograph to work through the speech amplifier of the modulator for domestic use. Furthermore, with the front doors closed, it had to look as innocent as milady's escritoire, which indeed it was.

The results, while not very startling from the point of view of radio theory, merit the attention of amateurs who appreciate a neat piece of design. Working at such close quarters, the utmost care had to be taken in the allocation of space to the various units, while at the same time preserving the goals of accessibility, safety, and flexibility of control.

The upper third of the secretary was covered by a horizontally swinging door which formed the writing desk when lowered. Behind this a clear space was made by removing miscellaneous partitions and cubby holes. In the lower right-hand corner of this space was mounted the communications superhet receiver. To the left of the receiver we placed the r.f. end of the transmitter. Directly above it, the speech amplifier and control panel were mounted. All the chassis and panels are of ⅛" thick aluminum. They were first cut and drilled, then sent out to be engraved and gray crackle sprayed.

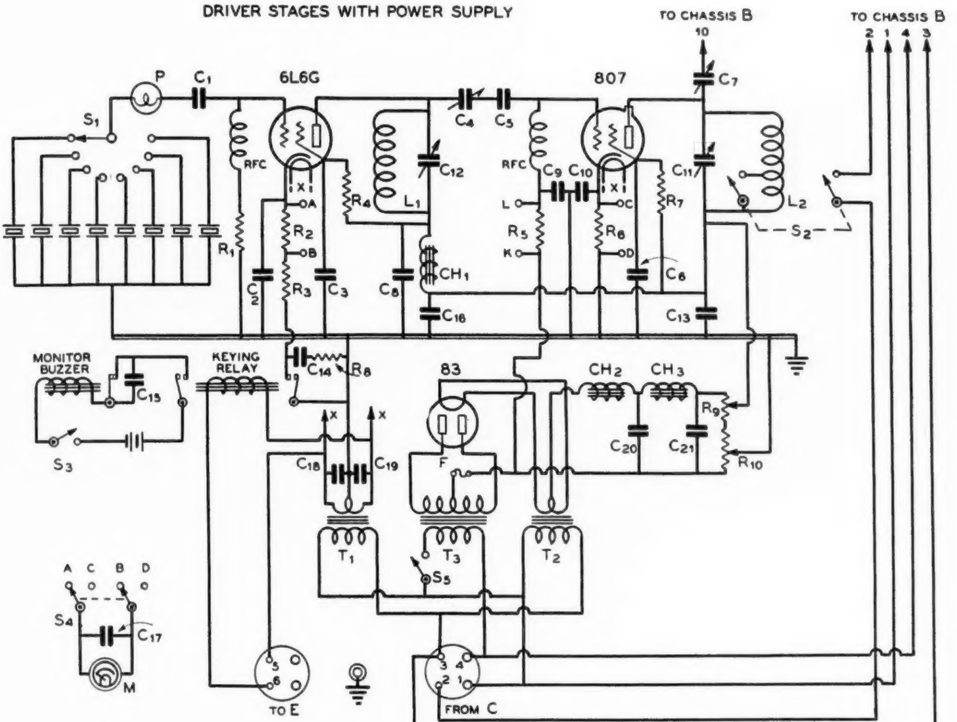
The bottom two-thirds of the secretary consisted of a tier of three drawers 18" wide, 7" high, and 12" deep. The top drawer was reserved for odds and ends, the middle drawer received the class-B modulator and power supply, while the phono turntable and pick-up were put in the bottom drawer. There remained a volume 21"x13"x12", covered by a vertically swinging door. The open space was fronted with a piece of matching wood and divided into two sections, the top one containing a ten-inch PM dynamic speaker and the receiver "B" supply, the bottom the main 300-watt power supply for the transmitter final.

R. F. Lineup

The r.f. end of the transmitter was simplified considerably by W2HMD's operating habits. Since he works exclusively on 10 and 20, band-switching by means of the shorted-turns method proved compact and practicable. The oscillator is a 6L6G, an 807 functions as buffer-doubler, and the final uses one of the new 50-watt beam tetrodes with about 1250 volts on its plate. The oscillator is controlled by any of eight 20-meter crystals, selected by

CHASSIS A

DRIVER STAGES WITH POWER SUPPLY



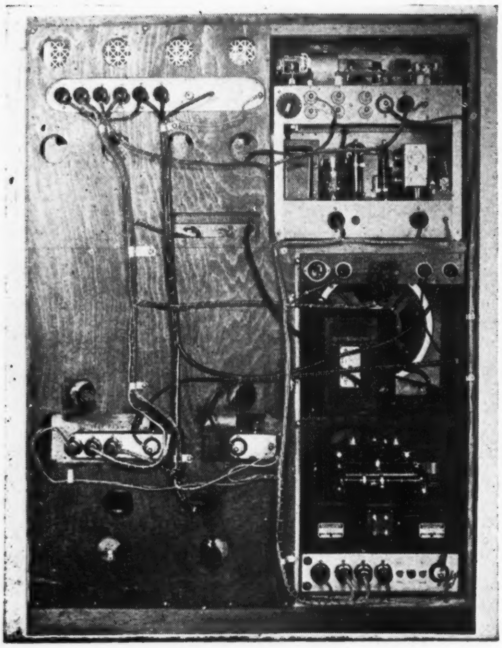
C_1—.0001-µfd. mica
C_2—.0005-µfd. mica
C_3—.001-µfd. mica
C_4—15-µµfd. midget variable
C_5—.0001-µfd. mica
C_6—.005-µfd. mica
C_7—25-µµfd. midget variable
C_8—.002-µfd. mica
C_9—.001-µfd. mica
C_{10}—.005-µfd. mica
C_{11}—30-µµfd. midget variable
C_{12}—50-µµfd. midget variable
C_{13}—.001-µfd. mica
C_{14}—0.5-µfd. 600-volt tubular
C_{15}—0.1-µfd. 400-volt tubular
C_{16}—.002-µfd. mica
C_{17}, C_{18}, C_{19}—.005-µfd. mica
C_{20}, C_{21}—8-µfd. 450-volt electrolytics
R_1—50,000 ohms, 1 watt
R_2—10 ohms, 10 watts
R_3—400 ohms, 10 watts
R_4—10,000 ohms, 10 watts
R_5—100 ohms, 10 watts
R_6—10 ohms, 10 watts
R_7—5000 ohms, 10 watts
R_8—40 ohms, 10 watts
R_9—1000 ohms, 40 watts
R_{10}—15,000 ohms, 25 watts
RFC—2½-mh. 125-ma. r.f. chokes
L_1—12 turns no. 18 d.s.c., 1¼" dia., spaced to 1"
L_2—11 turns no. 18 d.s.c., 1¼" dia., spaced to 1" and tapped 3½ turns from gnd. end
CH_1—30-hy. 50-ma. filter choke
CH_2—5-hy. 150-ma. swing choke
CH_3—15-hy. 150-ma. filter choke
T_1—6.3-volt 3-amp. fil. trans.
T_2—5-volt 2-amp. fil. trans.
T_3—900 v. c.t., 150-ma. power trans.
S_1—Crystal selector switch
S_2—Two-circuit bandswitch
S_3—Buzzer on-off switch
S_4—Meter switch
S_5—Plate on-off switch
M—0-100 d.c. milliammeter
P—6.3-volt pilot lamp
F—250-ma. fuse

means of a front panel switch. This means a choice of eight crystal-controlled frequencies on either band. To save space, the crystals are mounted turret-wise on a dress-up coil can.

The transmitter is mounted on two similar chassis, 9"x12"x3". These are mounted one above the other on a panel 15¼"x13¾". The lower one, chassis A, has the driver stages, while the upper one, chassis B, bears the final. Chassis A also contains power supply for the driver.

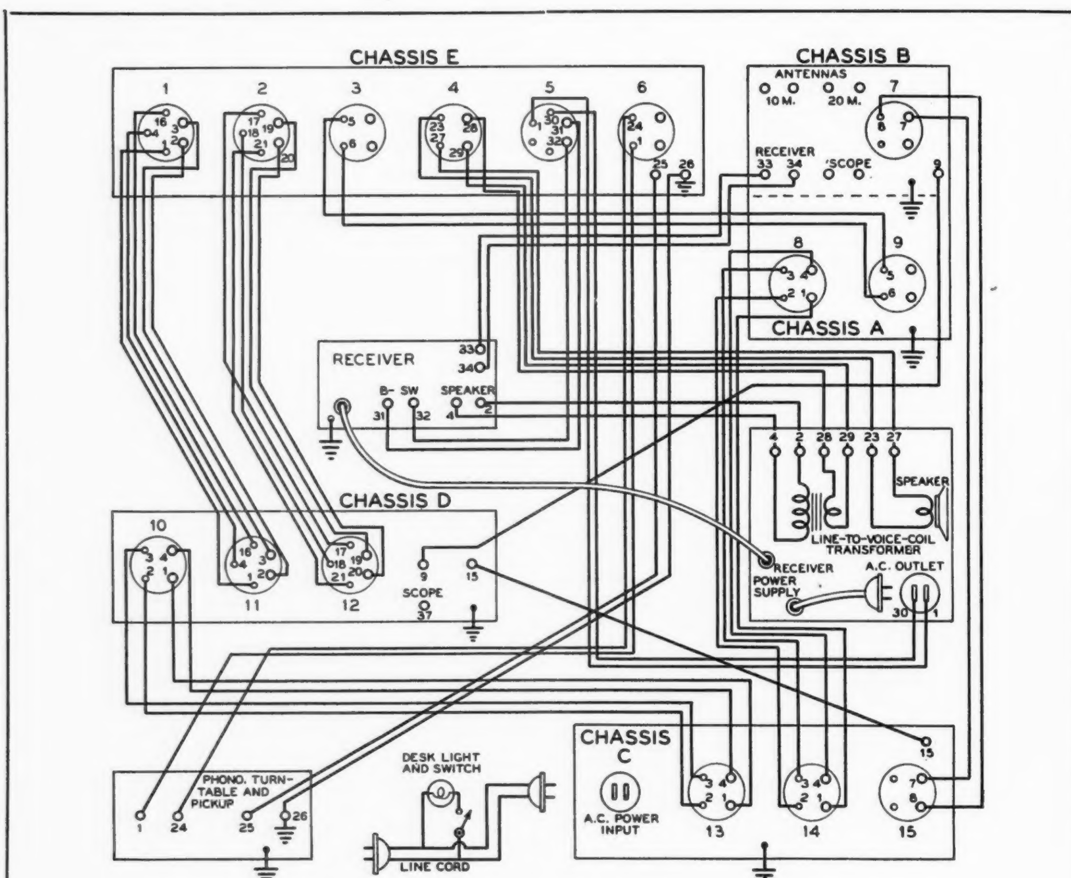
Capacitative coupling between stages is used only because of lack of room. Link or straight inductive coupling is much to be preferred. We have found that the coupling condenser's value is fairly critical, and this has necessitated the use of small variables in this position. Otherwise the troubles have been surprisingly few. The base and input section of the final have been shielded, and no feed-back has been experienced.

A number of refinements have been incor-



Rear view of the entire unit of the "Manhattan transmitter."

Plate, grid, and screen supplies for the RK-47 final amplifier (chassis C).



Complete diagram of the interconnections of the various units.

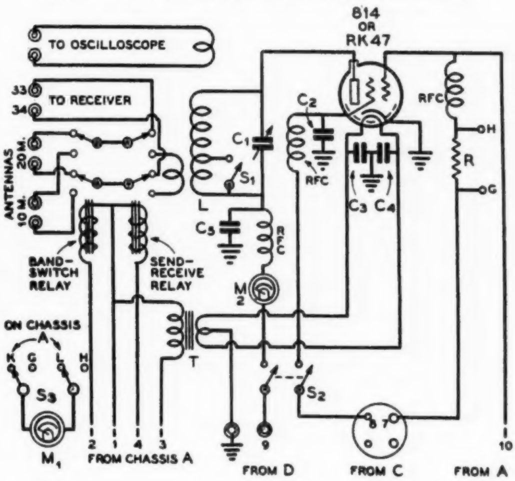
porated here which are worthy of attention. First, the problem of metering: We have used a method which for some reason is rarely employed by the amateur who, because of economy or lack of space, must use one meter to read current in two or more circuits. It is by far superior to the objectionable plug-and-jack method and even to the new special switches brought out for the purpose.

In effect, the meter shunt is left permanently in series with the circuit through which it is desired to read current, and the meter is simply connected across the shunt whenever necessary. Since the shunts are of low resistance, the loss in voltage through them is negligible. Thus, in our case, the meter shunts are left permanently in the cathode circuits of the 6L6G and 807 respectively. Leads a, b, c, d are brought out to a d.p.d.t. switch, with the switch arms across the milliammeter. Cathode current instead of plate current is therefore easily read for either tube, but this is good enough; in any case, the same system could be used in the plate circuits. Similarly, leads g, h, l, k are brought out to a second switch and low-scale meter to read grid current of the 807 and the final. A third meter reads final plate current all the time. Had it been necessary, one meter could easily have been used for all of this, but even so a great saving is effected.

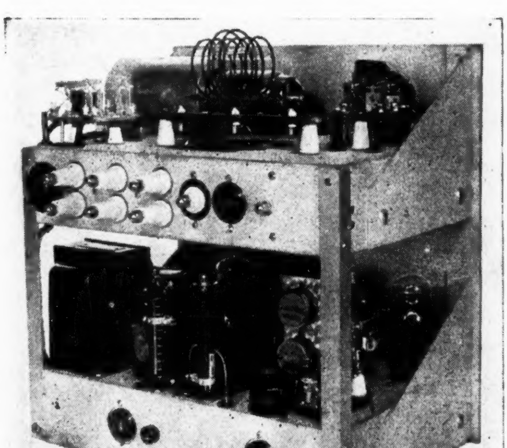
Second, a pair of relays mounted on chassis B perform some interesting functions. It will be noticed that the band switch in the 807 tank has an extra pair of contacts. Since separate

CHASSIS B

ANTENNA SWITCHING SYSTEM AND FINAL AMPLIFIER



C1—30-μμfd. 3000-volt variable
C2—.005-μfd. mica
C3, C4—.005-μfd. mica
C5—.001-μfd. 2500-volt mica
R—20-ma. meter shunt
RFC—2½-mh. 125-ma. chokes
S1—Final tank bandswitch
S2—High voltage safety switch
S3—Milliammeter switch
L—20 turns no. 10 enameled, 1½" dia., spaced to 5" and tapped 5 turns from ground
M1—0-10 d.c. milliammeter
M2—0-200 d.c. milliammeter



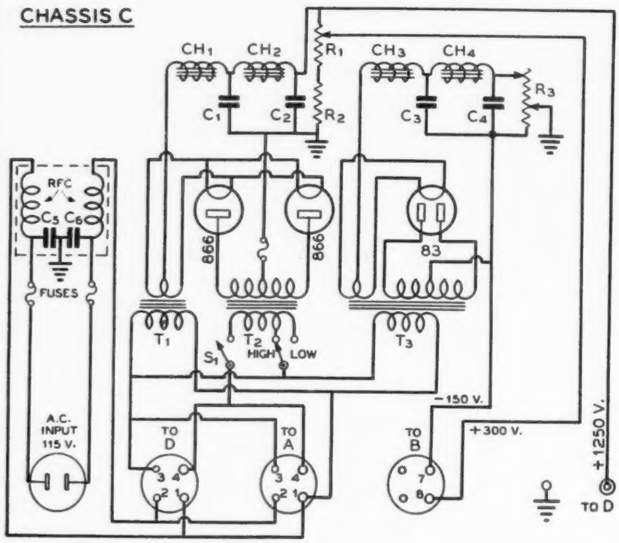
Rear ¾ view of the transmitter showing chassis A (lower) and chassis B (upper).

antennas are used for each band, this pair of contacts is used to close a d.p.d.t. relay which then connects the 10-meter antenna to the output. The other relay is similar, but is controlled by the plate switch. When this is open, the proper antenna for the band in use is switched automatically to the receiver. At the same time, and also by means of the plate switch, a closed-circuit relay in the B– lead to the receiver is actuated. This relay is normally closed, but when the transmitter plate switch is on, it opens and the receiver goes dead.

This system therefore accomplishes three desirable things: (1) The proper tuned antenna (i.e., the transmitting antenna) is employed by the receiver for the band in use; (2) transmitter noise is kept out of the receiver during transmission; (3) all this is accomplished by the single manual operation of throwing the transmitter plate switch. It might be added

FINAL AMPLIFIER PLATE & SCREEN SUPPLY AND BIAS SUPPLY

CHASSIS C



C_1, C_2—2-µfd. 2000-volt condensers
C_3, C_4—8-µfd. 450-volt electrolytics
C_5, C_6—1.0-µfd. 400-volt tubular
R_1—30,000 ohms, 75 watts, slider type
R_2—25,000 ohms, 40 watts, fixed
R_3—15,000 ohms, 25 watts, slider type
T_1—2.5-volt 10-ampere filament transformer
T_2—2800 volts c.t., 200-ma. power transformer
T_3—500 volts c.t., 40 ma.; 5 volts, 3 amperes
S_1—Plate voltage on-off switch

that using the transmitting antennae for reception, aside from being good for reception, saves roof-space for the apartment-dweller, who generally has very little.

Since fixed bias is used on the 807 and final, it is possible to key in the cathode of the oscillator. The keying relay has double contacts, one pair of which keys a buzzer, very useful with a bug. A switch on the front panel cuts out the buzzer if desired.

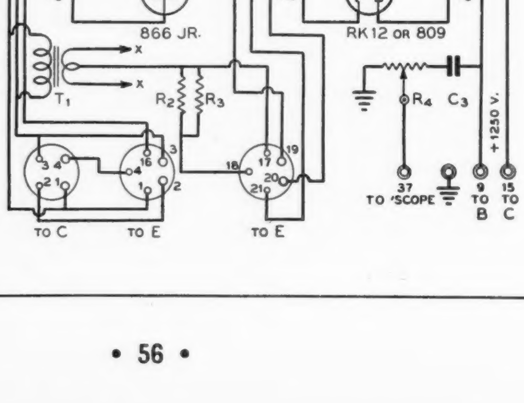
The only thing the outfit doesn't have is a built-in oscilloscope. It would have been there, but there simply was no place to put it where it could have been seen, not even a measly one-incher. The next best thing was to make provisions for an external oscilloscope, and this was done by bringing out a pair of leads from a small pick-up coil permanently coupled to the amplifier tank.

The class-B modulator and power supply (chassis D), which can just be seen in the middle drawer, employs a pair of 809's or RK-12's for audio and a pair of 866 jrs. for power. The chassis dimensions are 10"x17"x2". Audio excitation is supplied from the speech amplifier, which will be described later. The condenser C_3 and potentiometer R_4 provide for trapezoidal patterns on the oscilloscope, in conjunction with the r.f. pick-up coil noted above. Since the modulator is not visible, the plate milliameter had to be mounted on the speech

(*Continued on Page 90*)

CHASSIS D

MODULATOR AND MODULATOR POWER SUPPLY



C_1—1500-volt 2-µfd. filter condenser
C_2—1000-volt 4-µfd. filter condenser
C_3—.02-µfd. 5000-volt mica
R_1—25,000 ohms, 75 watts
R_2—10 ohms, 10 watts
R_3—250-ma. meter shunt
R_4—1.0-megohm potentiometer
T_1—6.3-volt 5-amp. fil. trans.
T_2—2.5-volt 5-amp. fil. trans.
T_3—1700 v. c.t., 225 ma. power trans.
T_4—Class-B input trans.
T_5—Class-B output: 9000 ohms p.-to-p., 8300 secondary
CH_1—5-25 hy., 225-ma. swing choke
CH_2—10 hy., 225-ma. filter choke
F—250-milliampere fuse

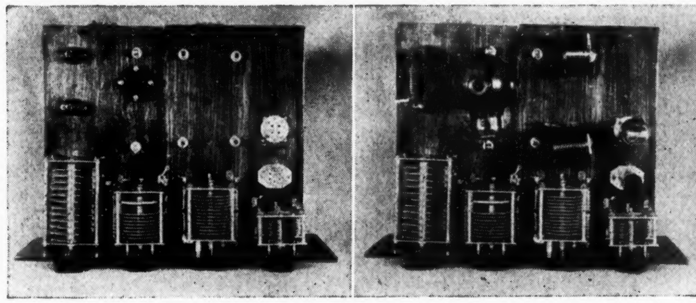


Figure 1. Horrible example No. 1, the old buffer unit at W9FM. Symmetry of design alone does not make for perfect operation.

TROUBLE SHOOTING *in R. F. Stages*

By E. H. CONKLIN*

Not so very long ago—about fifteen years—most of the wire in a "wireless" transmitter was in a 25-turn inductance. With it, we could get down to about 240 meters if the radio inspector put enough pressure on us. A little later, a few receivers were pared down to well below 200 meters and some good contacts across the country and the Atlantic became possible using considerably less than a couple of kilowatts. There followed a mad rush to remove the bases from tubes, and otherwise to cut down on all possible losses in an attempt to get "low loss" circuits that wouldn't catch fire now and then, and actually tune down to a wavelength of nearly 100 meters.

Since those years, when the battle cry was "Spark Forever", we have learned a lot. The 1933 model four-band transmitter at W9FM looks more like the dark ages than a 1929 Ford. Particularly, we have found out how to generate real power at frequencies which not so far back were considered a toy. We have applied our ultra-high frequency construction technique even to the lowest wavelength bands, thus eliminating many "bugs" which a few years ago were commonplace.

True, some fellows have rigs which are satisfactory for one frequency only, but mostly they are kidding themselves if they think that they won't have to rebuild for greater flexibility in the next few years, especially if they are working below 80 meters. When the last W9FM rig was put together with various evidences of the depression incorporated in it, the 28-Mc. band was a waste of time, 14 Mc. went dead at 5 p.m., 7 Mc. passed out by 7 or 8 p.m., and a skip developed even on 3.5 Mc. during the evening. Should we not plan for 1943 or thereabouts, the next minimum of the sunspot cycle, when we shall again be forced to crowd the lower frequency bands?

While there have been a number of excellent articles on the subject of proper transmitter design,[1] much of the knowledge is unwritten, being a result of personal experience and acquaintance with layouts used by others. We see final amplifiers with nearly a kilowatt on a 250TH using only a 35T driver, without a bug from 28 Mc. to 3.5 Mc. Occasionally we see sets that pop into oscillation or have other difficulties. The owners of the latter kind of rig can still afford to read about the troubles others have had, and the cure—which, often, is revising the layout.

Long Leads

In a push-pull stage, both sides of the circuit should be symmetrical, but symmetry of design alone does not make for perfect operation, even though neutralization is complete. The old buffer unit at W9FM, shown in figure 1, was laid out so that there were equal length leads in the plate and neutralizing circuits, but proper design in cramped space, with tuning condensers mounted on the panel, was not accomplished. On the higher frequency bands, the tubes were too hard to drive. This is attributed to the parasitic circuits which are pres-

*Associate Editor, RADIO.

[1]G. W. Fyler, "Parasites and Instability in Radio Transmitters", *Proceedings I.R.E.,* September, 1935, page 985. The material in the present article and in the R.C.A. Transmitting Tube Manual TT3 includes only part of the points mentioned by Mr. Fyler.

ent and to the fact that the inductance of long leads from the tube through the tank condenser to the filament reduces the useful voltage at the next grid. This is illustrated in figure 2.

Parasitic Oscillations

Parasitic oscillations are those of a spurious nature other than the normal oscillation for which the vacuum tube circuit was designed. They are also referred to as "bugs," which should be removed for the stage to operate satisfactorily. They may cause additional signals (which are often rough in tone), other than normal harmonics, hash on each side of a modulated carrier, voltage breakdown or flashover, instability or inefficiency, and shortened life or failure of the tubes. They may be damped and stop by themselves after keying or on modulation cycles, or they may be undamped and built up during ordinary unmodulated transmission, continuing if the excitation is removed. They may be at audio or radio frequency, in either type of amplifier (though only the r.f. amplifier is treated in this discussion). They may result from series or parallel resonant circuits of all types including the dynatron. Due to the neutralizing lead length or the nature of most parasitic circuits, the amplifier is not usually neutralized for the parasitic frequency.

The old method of removing such difficulties, when transmitters were simple oscillators, was to try some other type of circuit—the new layout automatically changing the circuit conditions. Adjusting the circuit to detune the parasite or putting in a resistor to damp it, are more useful than the more common amateur remedy of increasing the C-bias enough to prevent more serious effects on the apparatus.

Sometimes the fact that the plate supply is keyed obscures parasitic oscillations that might be very severe if the plate voltage were left on and only the excitation removed. Leroy Moffatt, W9IJ, has used a test for parasites in r.f. amplifiers which is somewhat more exacting than other methods commonly used. The grid bias is reduced to zero or even run positive. The plate voltage is then reduced to the point where the input does not far exceed the maximum permissible plate dissipation. If the excitation is then keyed, with the plate voltage remaining on the tube, any weak tendencies to oscillate will have an unimpaired chance to build up. If the stage will operate normally when in this class-A condition as well as at normal plate voltage, there is little likelihood that it will pop into oscillation at any frequency, or on any part of a modulation cycle, when in normal use.

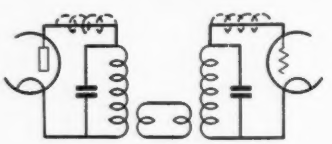


FIGURE 2

Simplified circuit showing undesired inductance in plate and grid lead.

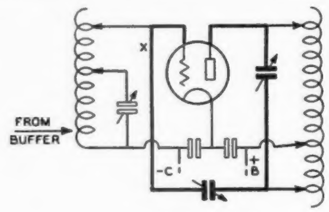


FIGURE 3

Parasitic oscillation through neutralizing circuit shown in heavy line.

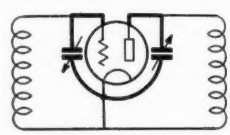


FIGURE 4

Simplified circuit showing important placement of tuning condenser close to tube to shorten t.p.-t.g. parasitic circuit.

In some cases, an all-wave receiver or an all-wave wavemeter will prove helpful in finding out if the amplifier is without spurious oscillations, but it may be necessary to check from one meter on up, to be perfectly sure. A normal harmonic is weaker than the fundamental but of good tone; a strong harmonic or a rough note at any frequency generally indicates trouble.

If a parasite persists with the excitation removed, without overheating the tube, the stage can often be dismanteled piece by piece until the offending leads or parts are located. Sometimes the glass bulb of a neon tube can be used to explore the circuit but if the neon tube is heavily coupled to the leads, the oscillation may stop.

When one parasitic oscillation has been cured, another that was previously too weak to get going may start. But don't let it be dis-

couraging. Some twelve different types of oscillations were removed from the WLW transmitter before stable and efficient operation was attained.

A familiar type of unwanted oscillation often occurs in shunt-fed circuits in which the grid and plate chokes resonate, coupled through the tube's inter-electrode capacity. It can also happen with series feed. This oscillation is generally at a lower frequency than the desired one and causes additional carriers to appear, spaced twenty to a few hundred kilocycles on either side of the main wave. One cure is to change the type of feed in either the grid or plate circuit or to eliminate one choke. Another is to use much less inductance in the grid choke than in the plate choke, or to replace the grid choke by a wire-wound grid leak of 100 to 10,000 ohms depending upon the class of amplifier.

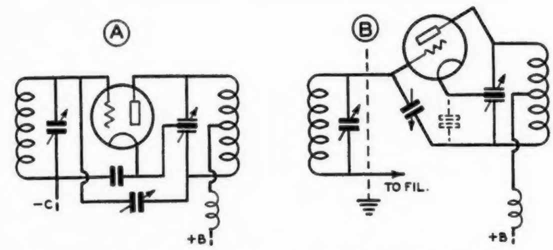


Figure 5A. Ordinary single-ended circuit diagram. Figure 5B depicts symmetrical layout with equal plate and neutralizing circuits from grid terminal. See text for details.

This form may take place in push-pull circuits, in which case the tubes are effectively in parallel for the parasite and the neutralization is not effective. The grids or plates can be connected together without affecting the undesired oscillation.

Experience with a transmitter at W9MZ, some ten years ago, illustrates the nature of u.h.f. parasitic oscillations in long neutralizing leads. The set operated well on 20 and 40 meters, but on 80 the final wanted to draw an ampere of plate current, oscillating inefficiently below 4 meters when normal voltage was applied. After much work getting the plate current down to where there were a few seconds to look for the trouble before the power had to be removed, it was noticed that a hand placed anywhere near the neutralizing condenser became slightly warmed due to the parasitic u.h.f. currents. The grid and plate inductances could be removed after the u.h.f. oscillation started, without disturbing the troublesome circuit. Chokes in the plate or grid leads were not satisfactory because they reduced the normal power output before they stopped the unwanted oscillation. Articles had appeared discussing parasitic troubles, but none covering this particular type, shown in figure 3, had come to our attention. This is an ultra-audion or series tuned oscillator which can be stopped by placing a few turns of wire in the *neutralizing* lead, at the point marked X.

The same difficulty was later encountered in a 210 buffer stage which operated satisfactorily when an 852 was used in the same layout. This time, however, removing the filament by-pass condenser also proved to be a cure. A third time that this occurred, the stage neutralized satisfactorily but when the power and excitation were once turned on, the oscillation persisted after the excitation was removed; with the small choke in the neutralizing lead, all was well except that the neutralizing condenser had to be reset on some bands.

A non-inductive-resistor of a few ohms up to perhaps 50, as a damping resistor, might have been better than the small detuning choke which made re-neutralization necessary on several bands. The use of a split-stator tank condenser with grounded rotor might also have been a cure. A suggestion has been made[1] that the grid tank connection could have been placed in the center of the small detuning coil rather than directly on the grid terminal, permitting a balance of the inductance in the neutralizing circuit over a wide range of frequencies.

The Single-Ended Stage

We hear a great deal about short leads, but is this in itself the answer? Parallel rod oscillators have such long leads—the rods themselves—that ordinarily there isn't any necessity to use a tuning condenser. It is more likely that the answer lies in shortening the "by-pass" path from the tube plate or grid, through the tuning condenser, if one is used, and back to the filament, even if the inductance leads are long enough to reach into the next room. This type of construction is diagramed in simple form in figure 4. Likewise, the neutralizing circuit must be kept short. Another precaution is to avoid having a long filament lead providing a common coupling between plate and grid circuits.

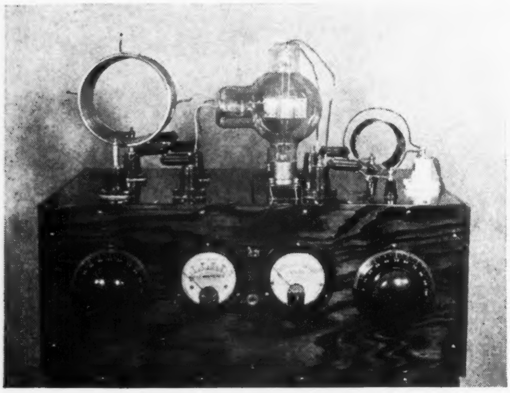


Figure 6. Horrible example No. 2. The old W9FM final with leads a couple of feet long between the tubes.

Some r.f. amplifiers will not neutralize completely. These are generally built similar to the normal circuit diagram, with a great deal of attention being paid to the shortness of grid and plate leads to the inductances, but none to the neutralizing lead and often neglecting the inductance through variable condensers. In order to neutralize properly a stage, the direct and neutralizing voltages not only must be of equal voltages but must also be of exactly opposite phase. If there is more inductance in one half of the circuit than in the other, or if the neutralizing circuit connection is not made close to the tube element, these two requirements are not exactly met. The ordinary single-ended stage shown in figure 5A might better be constructed as in 5B. In the latter, it will be seen that the two sides of the plate circuit are identical, with the neutralizing condenser on one side exactly balancing the tube plate-grid capacity and internal inductance on the other. These changes in a single-ended amplifier at W9RHK made it possible to neutralize completely the stage for all bands, and to drive it to high output and efficiency with a minimum of driving power.

There still exists a plate-filament capacity which normally is not duplicated on the neutralizing side of the plate circuit. When this causes unbalance, such as with tubes having a large output (plate-filament) capacity, a small trimmer condenser can be added between the tank side of the neutralizing condenser and ground as shown in the dashed lines of figure 5B.

Grounding the Split-Stator Condenser

In either the single-ended or push-pull circuit, a spit-stator condenser may be used. This condenser is seldomly made so that the middle of the rotor may be grounded, in which case a flat piece of spring brass may be arranged to slide on the rotor shaft at its center, making a short, low-inductance path to the filament circuit.

When one end of a split stator condenser frame is grounded, an unbalance may occur. A noticeable improvement on W6DHG's final, using a pair of 35T's plate modulated at 2100 volts, followed upon moving the ground to the center of one of the end-to-end braces. This still leaves a long inductive path to the rotor plates, however, and may not prove to be as good as arranging the central rotor contact.

Leaving the rotor ungrounded may increase the output of a stage if it adds regeneration, but the practice invites parasitic oscillations which would be shorted out by the ground connection. Using a single-section condenser in a double-ended circuit may have a similar effect; at W9GV, a push-pull circuit with a single-ended condenser developed a voltage that blew a hole right through the side of an 852. The tube promptly tried to outdo a rainbow for color as the "vacuum leaked out."

Closed Loops

When a tube circuit itself is not capable of generating spurious oscillations, a closed metallic loop in the framework or in a condenser may couple unwanted elements into a circuit, or link-couple the grid and plate circuits. The cure in this case is to open the loop or relocate the offending part.

The Push-Pull Stage

Another unit in which long leads between grids and tuning condensers made it hard to drive on high frequency bands, is pictured in figure 6. At the time, the layout seemed to be a good idea, with tubes out where they can get plenty of ventilation, inductances handy for band-changing, and the rest of the apparatus down under the base where it is out of the way. The inductive path between the tubes, however, is a couple of feet long. The wires on the plate inductance as seen in the photograph are taps for the single-wire-fed antenna for the several parts of the 7-Mc. band. The grid link replaces a rubber covered turn that caught fire after using up a lot of the much-needed excitation power.

The important leads which should be short, are the heavy lines in figure 7. The neutraliz-

[*Continued on Page 92*]

FUN ON THE FARM

Wide-eyed amazement is shown by the cow, as W1APA and W1APW amuse themselves with the power lawn-mower and a wagon at W1GRU's home.

—W1LIG

DEPARTMENTS

- **Dx**
- **Postscripts and Announcements**
- **Book Reviews**
- **Question Box**
- **56 Megacycles**
- **Yarn of the Month**

DX

HERB. BECKER, W6QD

Readers are invited to send monthly contributions for publication in these columns direct to Mr. Becker, 1117 West 45th Street, Los Angeles, Calif.

The past few weeks certainly have been filled with events. So much so, in fact, that if anything like it happens again very soon you'll be sending your dx news to the DX Ed. who will be in a bug-house. Laugh, doggone it, laugh . . . . but read on and see if you can take it.

W8CRA Married

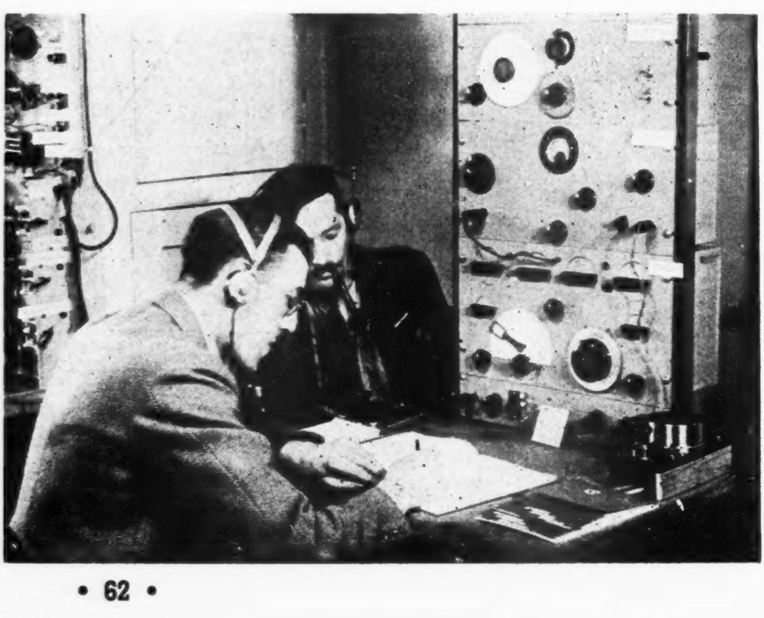
Through a W8 operative, it was finally discovered that Frank slipped one over on the bunch of us and was married somewhere around a year ago. I imagine the guy figured he would take a beating from the dx gang if he broke loose with the news. Anyway it couldn't last forever because . . . W8CRA is NOW A DADDY. In case you don't believe what you have just seen, Frank is a "poppa" and says he is going to make the Jr. op. the youngest ham in the world.

Howya doin' gang, are ya still with me? If you are, hang on 'cause here goes again. A week or two ago while prowling around the band I happened to be listening to a few phone stations. I lit on one of 'em who was working W5DNV and his conversation interested me. He said something like this to W5DNV, "Say, fellow, what do you know about grid modulation? I've been fussing around all day with this darn thing, trying to grid modulate this Gammy. How much bias do I need? What is the best way to swamp the soup out of the grid tank? How do you tell when you're modulating enough?" You surely have guessed it by now . . . W8CRA on PHONE!!! Now, howya doin'? Can you imagine . . . a No. 1, c.w. dx man with three accomplishments like that within a year. We really should add a zone to Frank's total for this, but on the other hand let's make him work for that zone 23 . . . just as a sort of a penalty for keeping it a secret. Before words fail me altogether. I want to extend my congratulations, and fellows, when you work Frank . . . just let him have it. Whew, this is too much for me. Hurry, James, a bromo.

Who Wants Zone 19

Now that we all have eavesdropped on Cannonsburg, let's take a look around and see what else we can dig up. Here's something . . . does anyone want Zone no. 19? Hey, don't all rush at once, and I'll let you in on it. W7FST, C. W. DeRemer, has left for Kotzeboc, Alaska, where he'll have about 500 watts. Twice a month he will be going over to East Cape, which is in zone 19. Incidentally, for the fellows who have worked him as K7FST at Wrangell Island he will still send them a card providing they drop him a line. Yes, pal, Wrangell is in 19, too. However from Kotzeboc he will send a new five-color card . . . and is making plans for plenty of contacts as he is having 10,000 printed. This should be a good chance to get after this zone as it seems pretty tough for most of the fellows to get a card out of a U in that zone.

Welcome to F8VC and F8KI who have just reported for the first time. F8VC uses phone only and has 22 zones and 42 countries. His rig consists of an RK20 modulating the suppressor grid, with an input



F. "Dud" Charman, G6CJ, and Jack Payne, G6PR, at the former's station in Stoke Poges, Bucks, England. Charman is an expert on antennas.

of 47 watts. His antenna is a full wave Hertz Windom. During the past two months F8VC has made WAC 10 times. F8KI has done fine work and has 26 zones and 53 countries to his credit . . . of course on phone. F8KI says his "handle" is Jean and pronounced Gene. A line from VK2EG tells that he has added a couple of zones in YR5AA and VU2AN. This makes him 33 and 69. VK2EG is on c.w. Here's just a glance at what's going on in Racine, Wisconsin. W9KYU runs 165 watts to his 35T and has 23 zones and 63 countries. W9KYJ has 50 countries and W9KZZ has 40 so far. W9YNB runs about 160 watts and claims 23 zones and 45 countries. YNB is really going after them and should have no trouble getting ahead. He uses an 8JK antenna for one skywire and the other is a sort of a "sawed-off" Vee beam.

W3AIR informs us that G6DH, who is well known on 28 Mc., is on his way to look over the States, as a matter of fact at this time he should be just about arriving in Montreal. He'll be around, so keep your ears primed for an "accent". Remember Doc Hard . . . well, he is signing XE1GE and is on 28-Mc. phone. W4BBP was the first W station to work FR8VX on 10 meters, and this all happened on that very fine day, February 13, 1938. I expect this will draw about a dozen other come-backs that they were the first. Watch out now, gang! There was a slight rumor to the effect that YV6AL, along with several others, were phoney but W4BBP has a card from YV6AL who gives his address as Apartado 35, Ciudad Bolivar, Venezuela, S. A., and is old W4IH. I see that my old friend Fred Elser, W6GVU, is now in Springfield, Mass., and has a new call, W1KOM. Fred used to be KA3AA.

A line from XU8XA, in Shanghai, says that he is gunning for W1, 2 and 3 now . . . so there's your chance fellows. XU8XA suggests that the East Coast gang spread out a little more when working an XU. He continually has trouble when he opens up with a flock of W stations piling up on one frequency, with the consequence he has a heck of a time working one station. XU8XA is on the air every other evening from 4:30 to midnight, Shanghai time. (You figure it). For his frequencies see elsewhere in this section. Other XUs soon to be on 20, and probably are by this time, are XU8RL, XU8MR, XU8AG, XU8NR.

Snapped at Whitehead, Northern Ireland, by R. Barr, Jr., of GI5UR. On the left is Harry Langhorn, a pal of W. H. Faulkner, Jr., of W3BSY, who is standing next to him. Frank Robb, GI6TK, dressed in the light-colored suit, stands on the right.

PHONE

CT1AY	14050	SP2HH	14280-14025
FA3HC	14100	SU1KG	14070
HA1G	14100	VO6D	14260
HH3L	14255	VP1DM	14412
HK5DB	14010	VS1AI	14060
HP1A	28180	VS2AK	14150
J2MI	14100	VS2AS	14265
J7CR	14275	VU2LL	14285
KA2OV	14280	XU8ET	14100
PK2DF	14090	XU8RJ	14070
PK3AA	14270	XZ2EZ	14325
PK3WI	14140	YV1AP	14080
PK4CB	14156	YV1AQ	14000
PK4JD	14090	YV5AZ	14090
PK6XX	14006-14194	ZB1L	14125
		SM5OZ	14385

C. W.

AC4YN	14120	U5KN	14375
CR7AU	14240	UX1CN	14390
CT2BD	14360	VK9VG	14350-14100
FP3AA	14375	VO6D	14260-14400
GW3CR	14405	VO6J	14355
GW8CT	14410	VP6LO	14045
GW8WU	14390	VQ4KTF	14090
J8CD	14410	VQ8AB	14290
K6OCL	14050	VQ8AS	14325
LX1AG	14000-14425	VR1AM	7165
LX1AO	14410	VS3AB	14330
LX1AS	14405	XU6PZ	14310
OY4C	14350-14410	XU6TL	14325
PK5FF	14100	XU8XA	14198
PK7FF	14280		14236
SU1CR	14400		14336
SV1RX	14415-13990		14360
TA2N	14415	YV2CU	14420
TF5B	14415	ZC2L	14370

K6CGK, K6AKP and K6JPD think that FI8AC and ZE1JI are two of the most consistent hams on the air. I suppose there is such a thing as consistent hams *off* the air, too. Anyway the thing that makes my ears droop is a simple line from CGK which reads thus, "A number of K6's have worked AC4YN, so guess he is still on the air." Can you beat it. What do you say . . . let's all gaze into the crystal ball and with a power of concentration, maybe we can get om Fox of AC4YN on the air a little more. Every day I hear, "Oh, for that zone 23."

LU7AZ is figuring on the contest next year already. He is sure he can beat this year's score because he will be on 3.5 Mc. too. The rig at LU7AZ winds up with a single 150T with a kw. Milo brings up an interesting point regarding the South Orkney Islands. He claims that only the Argentine flag is there and should not be VP8 as we have supposed. The only inhabitants are the six members of the Official Scientific Commission who are changed each year in February. In 1934 there was an operator on the Commission, LU3BG. LU3BG had a number of QSO's with hams, and we are pulling for a ham to be selected on this commission for next year.

A very fine 4-page letter was received from LU3DH written completely in Spanish. If you don't think I had a swell time, because my Spanish is just about the same as my Arabic, which has hit a new low. Anyway after chasing through the Spanish dictionary, and with the aid of a dozen friends of mine "who knew Spanish", I finally have some very fine information. Each of these friends knew about

Here is L. Gregory of G2AI sitting at his station in 'Walcot', Uphill Grove, Mill Hill, London.

twenty-five words. One of the most important things that George brings up is the system of assigning LU call letters, and their areas. Contrary to general belief, the numeral in the call does *not* denote the district or province in which the station is located. The thing that governs where the station is located is the *first* letter after the numeral. For example, in the City of Buenos Aires they have the series beginning with LU1AA and ending with LU9CZ. This means that letters A, B and C are assigned to the city proper, and these letters are the ones appearing right after the numeral. Now then, for the Province of Buenos Aires they have the D and E series, in other words all calls falling from LU1DA to LU9EZ inclusive. The Province of Sante Fe has F and G. So fellows, you can work an LU2 and an LU7 and yet they will both be in the same Province. Just remember that the letter immediaately following the numeral denotes the Province.

To get on with LU3DH . . . he uses an RK20 with 100 watts input, has QSO'd 3000 W's and is lacking in cards from Delaware, So. Carolina, Arkansas, Nevada and So. Dakota. George has 33 zones and 81 countries, and among his prize contacts are those with LDIV, the searching Expedition for the dirigible Italia when it was lost at the North Pole, and with WFBT, the Byrd South Pole Expedition.

Upon opening a note from D3FZI, I discovered it was written entirely in German . . . or should I say "Deutsch". You don't realize how near this month's column came to being a total flop. I'll just have to "brush up" on my 14 foreign languages. Have no fears, because I have a "pull" and know what every line in his letter says, and on top of that I can read between the lines. D3FZI is anxious to trade some German made merchandise for used USA radio gear. This is not an ad but he apparently wants a rig using USA "valves" and an SW3. D3FZI complains of the few cards he has received from the W6's, and yet he has contacted 70 or 80 of them. This is a good spot for the following announcement.

Contests

The DJDC 1938, German DX Contest will be held during the four weekends of August, starting with August 6th. Each weekend from Saturday 1200 G.m.t. to Sunday G.m.t.

The 1938 VK-ZL Contest will be held during the weekends of October, 1938. The first two weekends will be devoted to the Senior Division, and the last two, to the Junior Division. Each weekend starting with October 1st at 1200 G.m.t. and ending at 1200 G.m.t. Sunday. The same to be repeated the next weekend starting with 1200 G.m.t. October 8th.

What the C.W. Men Are Doing

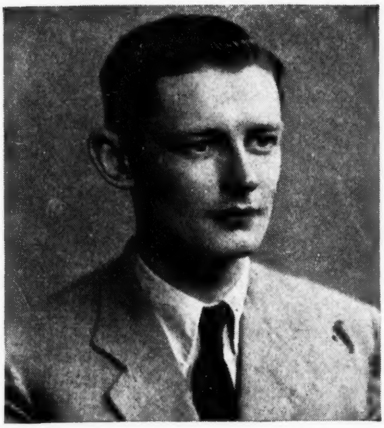
W7AYO complains about not being able to work anything, but sends in 9 additions to his countries, now making 90. New ones for Stan are K6TE, K6NVJ, FI8AC, VR6AY, SV1RX, HH4AS, etc. His zones stand at 35. Stan is going to put a beam antenna in preparation for the DJDC contest in August. Says the hardest part is to get the poles down out of the mountains. W9UQT is in again, and this time he is a little peeved at himself for being so considerate of OY4C. It seems that on a certain night when OY4C was coming through he called CQ "not USA". W9UQT said he didn't think this was entirely "cricket" on the part of the OY, because of being so rare, but he calmly stood by without giving him a call. The catch is when UQT listened in, there was a big signal calling OY4C . . . and then it signs W6CXW. To shorten it up a bit the OY comes back to Henry, and then 9UQT promptly inhales a deep breath and looks around for a brick wall to bat his skull against. His own head, I mean, not CXW's. The OY went into a fade so W9UQT is still minus one. However, Doc has not been as reluctant as all that because he has added seven new ones to his list and now has 38 and 110. A few of them are TF5B, GR7AN, LX1AS, VR4AD, VR6AY.

W3GHD joins the happy mob with his 34 zones and 90 countries. He runs 150 watts into a pair of T20's and is doing alright wth them. W6PBI is only 15 years of age and has only been on the air 10 months but has a good start with his 20 zones. W6CXW is getting back into condition after settling into married life, and finds it great stuff to work a few new countries for a change. He has added five which brings his total to 144 at the top of the 39 zone gang. As you've read before, Henry worked that rather elusive OY4C, FP3AA, K6NVJ, K6HCO, K6DSF and to show you that he doesn't fool he hooked three LX's in one night. LX1AG, LX1AS, and LX1AO . . . they must have had a contest. I guess the avocados are helping Henry with this sudden burst of enthusiasm.

Here's That Man AC4YN Again

G5VU worked AC4YN on May 23, 1938, at 1745 G.m.t. and his frequency was about 14,120 kc. and the report to him was 449x. The rig at G5VU winds up in an RK25 with 25 watts input, while the receiver consists of a 6K7 detector and 6C5 audio. Stan Henton is this lucky guy's name and says he has worked 31 zones and 73 countries on a genuine 25 watts. Mebbe we're all using too much power??? Nice going, G5VU, and good luck to you in the future.

W5ENE worked the station signing CR6PG, and is not quite sure whether the guy is OK or not. Anyway, the CR6 passed along his QTH for anyone wanting to find out: Jean Phail, Rue 7 W112, Angora, Angola, West Africa. Ben is still using a pair of 852's and says they still like a kilowatt. For



This good looking chap is George Bolm, Manuel Castro 1851, Banfield, Buenos Aires. His call, LU3DH.

those who are collegiate, W5ENE attends Southern Methodist University. W8OXO pops up from nowhere with 34 zones and 90 countries. W9KG adds five countries with VR6AY, TG9AA, VK9VG, G5TZ, LX1AG. W6MXD passes along the QRA of XU8RB: XU8RB, Lane 159, House no. 6, Seymour Road, Shanghai, China. XU8RB uses an HK-354 class-B modulated, a Comet Pro receiver and two Vee beams. W6MXD also says that VS2AS told him that VS2AK is returning to England, so if you have any QSL troubles with him, take it up with Parliament.

W5BB is on c.w. and fone. New ones for Tom are HP1A, ES5C, J8CD, VK9VG, YU2CU, PK7FF, VO6D, VR4AD, VR6AY. His total is 38 and 118. W4BHY has worked a lot of nice stuff during the few months including FY8AE and CN8AS. W6KUT located in Fresno has been doing right well by himself, and now stands at 32 zones and 85 countries. Rig uses a pair of HK-354E's. W8JSU has been striving to get his 30 zones and has done so . . . in fact he has 31 zones and 58 countries. So far this year W8JSU has made WAC seven times. Says he's still plugging for WAC on 7 Mc. W8OSL is getting that good ol' summer feeling, so I guess that means he won't be very active for a while. W3GAU has hooked VQ4KTF and U5KN and K6OCL which boosts him up a few notches, 36 and 106. K6OCL is in Guam.

PK5KF in Netherlands Borneo

For those who want to take a fling at PK5KF you will find him around 14,100 with a T7 signal. His QRA: PK5KF, Broekhuigen, Balikpagan, Netherlands Borneo, Neth. East Indies. He has usually fired up around 0800 G.m.t. and stays in there for a few hours.

Lindy, W2BHW, hung around late one night and collected K6NVJ, K6BAZ, K6GNW and VR1AM . . . which gives him 132. W2GVZ has chased W10XAB for 10 months and finally landed him. Another good one for Pat is ZD2H. G2IO wants you fellows to look for UX1CN who is with the Polar Expedition, Rudolph Island, in the Franz Josef group. He uses two spots, one near the low frequency end of 14 Mc. and on the other end of the band, approximately 14,390 kc. Comes into G around 2000 G.m.t.

Zones and Countries

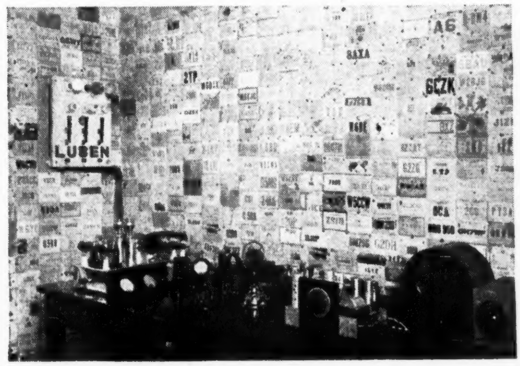
For the benefit of those who may have not seen similar explanations to this in previous issues of RADIO, I'll repeat: When you submit your number of zones and countries for the first time, we require you to send a list of the zones worked showing the call letters of at least one station for each zone. No cards should be sent in unless demanded, except when you have WAZ (Worked All Zones). In reporting the number of countries simply send the total number which you have worked to date. Your countries should be counted as per the Country List in RADIO for January, 1938. It is true that the way is clear for "chiselers" to boost up their countries, but I'm quite sure we would find the gang as a whole quite honest. A fellow would be kidding himself more than anyone else if he did choose to do some chiseling.

Say, gang, when you send in your reports every month, don't forget to show the frequencies for those stations worked . . . especially the most rare ones. Then, too, I like to receive photos of dx stations as well as W's . . . sooner or later we can use them. Send in all the dx news you can get, as this is *your* section, not mine. Let's make it full of information for the next guy. As a reminder . . . the next issue of RADIO will be the October number which will be out about the middle of September. However, darn ya, keep firing that news in all summer, and we'll really pour it into that October issue.

With the Phone Men

W7BVO got really lucky a short time ago and knocked off a fast WAC on 14-Mc. phone. The time was 1 hour and 45 minutes, and the stations involved were FA3HC, G5LJ, HK3GL, W7EYD, VK2VA and J2NG. This is about the fastest I've heard of in the 7th district, and Rollie now has 26 zones. W5BB likes to be what he calls a "balanced amateur". By that he means half his time on c.w. and the other half on phone. Now then, this "balanced amateur" has just taken in his 20th zone on phone, but didn't state his total countries on phone. Probably 20 countries, too. W6ITH hooked VK9VG and ES5D on 20 phone which gives him 67 countries. Reg had a letter from J2NG, a part of which is quoted: "The hours which we are allowed on the air are as follows: 2 a.m. to 4 a.m.; 6 a.m. to 8 a.m.; 10 a.m. to 12 noon; 2 p.m. to 3 p.m.; 4 p.m. to 6 p.m.; 10 p.m. to 12 midnight. All the times are J.s.t. which is 9 hours ahead of G.m.t.

[*Continued on Page 95*]



LU8EN began activities in 1926, was w.a.c. in 1927 on 15 watts of c.w. Present rig consists of a 59 crystal oscillator into a pair of RK-20's with 262 watts input. Suppressor grid modulated using a 56 into a 2A5. LU8EN has a 45-minute wa.c. to his credit, and has logged over 4000 dx stations. Countries worked are 81. The photo shows a very neat and well planned station.

POSTSCRIPTS...

and Announcements

List Your Call

W7FSH points out the advisability of listing your call in the local postoffice directory if you live in a town of any size. Thousands of SWL and QSL cards have been destroyed because of insufficient address. "Amateur radio W7FSH, Seattle, U.S.A." is a poor way in which to address a QSL card, but many foreigners address cards in just this manner.

Re "Modulation Transformer Design"

Two corrections in the text of the article "Modulation Transformer Design," by Lloyd W. Root, W9HA-W9EHD, have been brought to our attention. The first, mentioned by Mr. Root himself, is in regard to an error in equation (16) as it appeared on page 40 of the magazine text. In the second term of the equation, the square root sign should be only over the coefficient of A^2 and not over A^2 itself. This term of the equation should read:

$$+ \ 2\sqrt{98E\left(d_1^2 + \frac{d_2^2}{1.2}\right)} \quad A^2 +$$

The balance of the equation is correct as it stands.

The other error was brought to our attention by Douglas Fortune, W9UVC. It concerns the method of computation of the effective value of the resultant of the d.c. and audio current flowing in the secondary of the transformer. It was stated that since the d.c. current was 0.15 ampere and the r.m.s. audio current was 0.1 ampere, the secondary would be called upon to carry the sum of these two currents or 0.25 ampere. This, instead of being the effective value of the secondary current, is more close to the peak value of the current that will be carried. Actually it is somewhat in between the two, but a correct determination of the effective (or heating) value of the secondary current is obtained by integrating from zero to 2π the area under the superimposition of the audio wave upon the steady d.c. current.

If the superimposed audio waveform is of the form of a sine wave, the result of the integration is greatly simplified and comes down to the simple form:

$$I_s = \sqrt{I_{d.c.}^2 + I_{a.c.}^2}.$$

In other words, the heating value of the secondary current (and that is what we must consider when determining wire size) is found by taking the square root of the sum of the squares of the steady d.c. current and the *r.m.s.* value of the audio secondary current.

If the transformers are constructed according to the original design, there will be a factor of safety since the secondary wire will be capable of handling more current without heating than it will be called upon to carry. Or, if desired, the wire size may be reduced accordingly.

Paley Award

The 1937 William S. Paley Amateur Radio Award has been presented to Robert Tompkins Anderson, W9MWC, in recognition of his courageous efforts in providing communication between flood-stricken Shawneetown, Ill., and relief agencies which were attempting to bring help. Through his efforts the entire population of the community was evacuated to higher ground without loss of life.

The Paley Award was founded in 1936 and was given that year to Walter J. Stiles, Jr., W8DPY, of Coudersport, Pa., in recognition of his activities in furnishing the communication that brought food and clothing to the 4000 inhabitants of Renova, Pa., during the peak of the March, 1936, flood.

Radio Subscribers

If your call letters are not included on the stencil which addresses your copies of RADIO, we would like to add them. Just write on a postcard, "Add my call" and sign your name, call, and address—legibly, please. We'll do the rest.

Complaints

Several unsigned complaints have been received by our circulation department regarding non-receipt of copies of the RADIO ANTENNA HANDBOOK ordered recently. If you have sent in a complaint but have received neither an answer nor the book, kindly try again.

NEW BOOKS

AND REVIEWS of CATALOGS

***(Books submitted to the Review Editor will be carefully considered for review in these columns, but without obligation. Those considered suitable to its field will also be reviewed in* Radio Digest.)**

A new book, entitled "Electrolytic Capacitors", in which both radio and electrical men will find authenticated information on the theory, construction, characteristics and applications of electrolytic capacitors of all types, has just been published. Its author, Paul McKnight Deeley, is chief engineer of the electrolytic division, Cornell-Dubilier Electric corporation. "Electrolytic Capacitors" is available through the Cornell-Dubilier Electric Corporation, South Plainfield, N. J. Price: $3.00.

●

A Service Guide listing data on a new line of transformers is announced by the Standard Transformer Corporation, 1500 North Halsted Street, Chicago, Illinois. The new line, consisting of 14 different transformers, is suitable for use in servicing the majority of existing radio receivers. Through the use of a new type of mounting bracket arrangement the transformers may be used in a horizontal or vertical position, or they may be used in the conventional half-shell or Underwriter's type of mounting.

●

RCA has announced the release of two new booklets on vacuum tubes. One is the RCA Receiving Tube Characteristics Chart (1275-B) and the other is RCA Air-Cooled Transmitting Tubes (TT-100).

The Receiving Tube Chart 1275-B, in booklet form for convenience, gives characteristics data on all RCA glass, glass-octal, and metal types in numerical-alphabetical sequence. Socket connections with RMA designations are also given.

The Transmitting Tube booklet classifies RCA air-cooled transmitting types according to triodes, tetrodes, pentodes, rectifiers and miscellaneous types. While the characteristics of the individual tubes are not given, charts have been made up to assist the amateur in deciding upon the best tube to use in a particular class-B modulator, class-C amplifier (triodes are listed separately from pentodes and tetrodes), class-A amplifier or rectifier circuit. The tube types of especial interest are set aside in bold-face type and, in most cases, are illustrated in the text.

Copies of both of these booklets (1275-B and TT-100) may be obtained upon request from Commercial Engineering Section, RCA Radiotron Division, Harrison, N. J.

Wholesale Radio Service Company, 100 Sixth avenue, New York, active in the radio supply field for the past twenty years, announces the publication of a catalog devoted entirely to cameras and photographic supplies.

Readers of this magazine will find a large selection of famous name cameras and photographic supplies. In addition, space in the catalog has been devoted to practical information and various tables to help make better pictures.

Copies of this catalog may be secured free of charge by writing to or calling at any branch of the Wholesale Radio Service company.

●

An enlarged catalog of stock Ohmite rheostats and resistance units for the industrial, radio and electronic fields has just been issued by Ohmite Manufacturing company. The catalog lists and describes the company's extensive line of vitreous enameled rheostats, resistors, tap switches, chokes, line-cord resistors, transmitting band-change switches, precision resistors, etc. Tables list the ohmage, current and voltage ratings of the different units. Copies of this catalog, entitled stock catalog no. 17, may be obtained from Ohmite Manufacturing Company, 4835 Flournoy Street, Chicago, Illinois.

Question Box

Three of us, last night, argued for four hours, hunted through text books, magazines, and various papers, and finally gave up in disgust on a question, the explanation of which is probably so obvious that it will floor us when we hear it. We evidently have slipped up on something, but it has us at present.

The "RADIO" HANDBOOK says resonance occurs in a tank circuit when the inductive reactance and the capacitative reactance are equal. From this we infer that at resonance a circuit is purely resistive and non-reactive.

Q is equal to reactance divided by resistance. If at resonance there is no reactance, how can there by any Q?

The answer to your question is so close to what you have already arrived at that it probably will floor you, as you have said; Q is equal to reactance over resistance all right, but it is not a function of the *net* reactance of the tank circuit but of the reactances of the capacitance and inductance that make up the tank circuit. That is where you made your mistake.

$$Q = \omega L/R, \text{ or } Q = 1/\omega RC.$$

In other words, the Q of a loaded tank circuit is equal to the reactance of the inductance that is used in that circuit divided by the coupled-in resistance due both to the losses in the tank circuit and to the external load that is coupled to it. It is also equal to the reciprocal of the product of the coupled-in resistance and the capacitative reactance of the tank condenser at its particular capacity setting, by definition in the equation given above.

56 MC....

By E. H. CONKLIN*

Well, plenty has been happening on "five" during recent months. We reviewed the news in a separate article in this issue, saving our editorial comments for this column. Last month we published W4EDD's telegram of May 15 with a couple of errors in it as given to us over the phone by the telegraph company; the new story will correct the calls.

Ionosphere Conditions

Ionosphere conditions for May 15 were commented upon by the National Bureau of Standards as follows:

"Replying further to your letter of May 15, our ionosphere records indicate no sporadic-E layer reflections at Washington on May 15. There was nothing on our records to account for 56-Mc. transmission. Since you report such transmissions between Miami, Florida, on the one hand, and New York, Philadelphia, and Pittsburgh on the other, we believe that there was strong sporadic-E layer at the midpoint of the path over eastern South Carolina at that time. This indicates that the clouds of sporadic E can at times be much smaller than 400 to 500 miles across."

According to our globe and more complete reports, we note that the midpoints of all QSO's were along the Atlantic coast from Brunswick, Ga., for Miami-Cincinnati contacts, along the edge of South Carolina up to southern North Carolina for the Connecticut QSO. Roughly, of course, this means that the layer was over eastern South Carolina. Detroit, Chicago and Dallas were within the usual 500-1200 mile range for sporadic-E layer communication but the layer apparently did not extend even to the northern parts of South Carolina or Georgia. Boston may be just outside this range (unless helped by low atmosphere bending at one end or the other) but other Massachusetts points were on the outer limit.

The fact that there are more good dx days for the southern stations than for Chicago to New York or Boston can be attributed to a number of things. The southern stations have improved their equipment considerably over last year and the more favorable latitude and transmission distance favors their working northern stations. W9WLX points out that everybody hears the dx this year—possibly attributable in part to improved equipment at the receiving end as well as more effective transmitters and antennas at W4EDD and W5EHM. Other W5's were not as widely heard.

It has been more usual at Chicago during recent summers to hear southern stations rather than eastern districts on 28 Mc., possibly because of more favorable distance and latitude. This year, W9QDA remarked that during fourteen days in early May, W2's came through on "ten" for short periods on three days while W5's came in for hours at a time on nine days. This situation has been the reason for our desire to urge southern stations to join in summer 56-Mc. dx attempts.

Use Unmodulated C.W.?

O. H. Mills, W8NED, heard 28 Mc. open to the west of Pittsburgh on May 22 and on 56 Mc. heard several stable carriers too weak to copy. He mentioned that if they had been keyed, they could have been copied.

On this same subject, we point out that the R.S.G.B. cup will be won by some station using c.w. only, for contacts over distances greater than 200 miles. See the contest rules published at the beginning of the year.

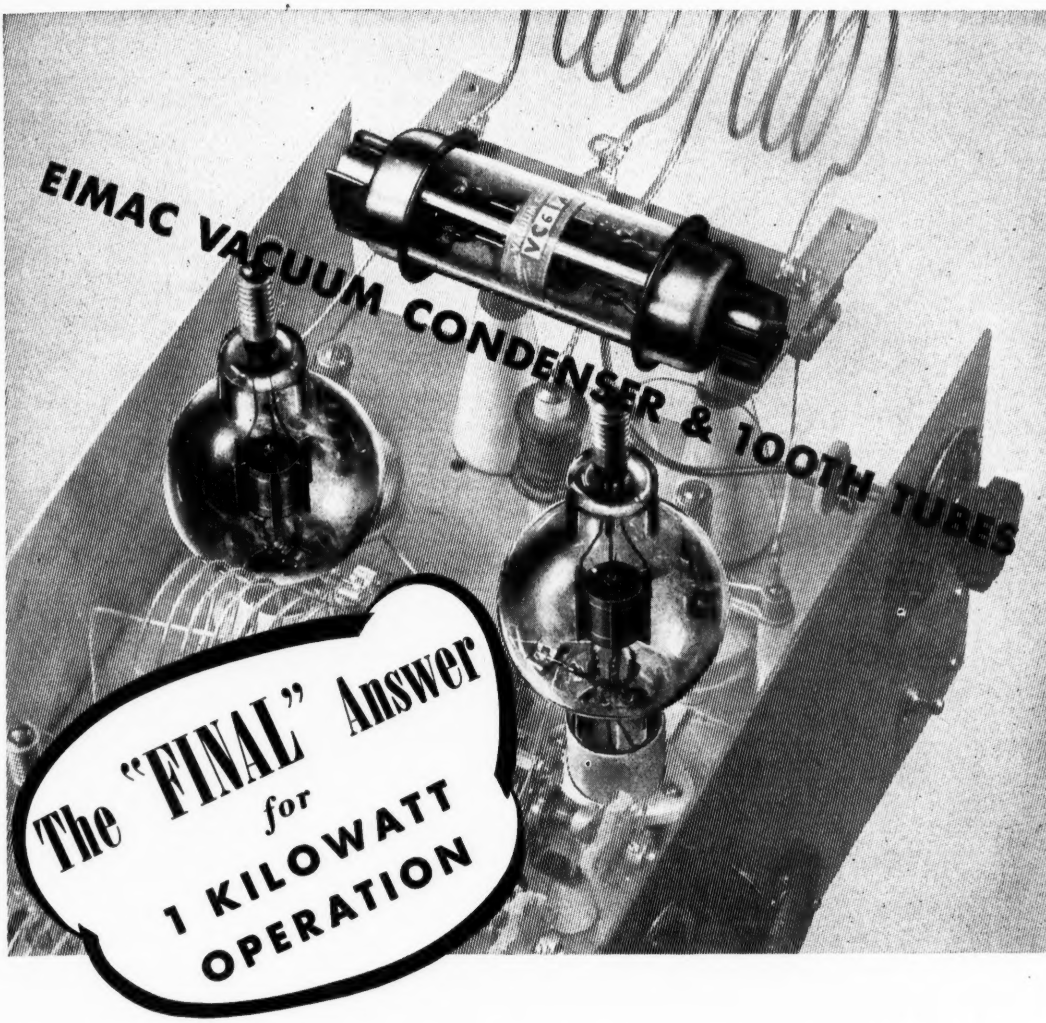
We wonder if there is sufficient interest in a winter dx attempt with Europe, South America, Australia, etc., for us to arrange another test for November of this year. Possibly the rules should be the same as for those last January and February. Let us hear from you if you are interested.

Receivers

The use of regular ham-band receivers on 56 Mc. is increasing. This requires operating the oscillator on 28 Mc., with a five-meter tuned circuit, coupled to the antenna, between detector grid and ground in place of the regular grid clip. No operations on the receiver are required. Some sets may not have suitable conversion efficiency on the oscillator's second harmonic. An additional capacity across the oscillator coupling condenser may help. A 1/6-wavelength concentric line with a small trimming condenser across the unshorted end, as

[*Continued on Page 88*]

*Assistant Editor, RADIO.



Here's the combination every radio operator has been looking for: 1 kilowatt input; 80% plate efficiency; minimum harmonic radiation; ease of excitation; full coverage of all amateur bands (5 to 160 meters); maximum power to the antenna and perfect operation on either phone or CW. At 3000 volts 330 milliamperes, 100TH tubes operate well within their ratings.

Circuit efficiencies in the order of 80% with harmonic radiation at a minimum results from the fact that the tank circuit is designed for optimum "Q." Since the entire tank capacity is confined to a space of but one cubic inch, it is easy to see why difficulties caused by stray capacities and high inherent inductance are eliminated. Tank circuits of optimum "Q" also insure the proper load balance on each of the tubes and reduce phone "splatter" to the very minimum.

With Eimac 100TH's and the new Vacuum Tank circuit you can expect and *get* a highly efficient and thoroughly practical 1 kilowatt amateur "rig."

Complete information about the Eimac Vacuum Tank Condenser is contained in an attractive four page folder. This folder may be obtained from your dealer or by writing directly to the factory. See your dealer today.

Eimac TUBES

EITEL-McCULLOUGH, INC., San Bruno, Calif.

YARN *of the* MONTH

Little Ham, What Now?

It's fellows like Toby Shannon that sometimes make me wonder about "ham radio". It seems likely that maybe this world is losing a lot of good doctors and lawyers and maybe bankers, because young twerps like this Toby will get so doggoned enthusiastic about their hobby that they'll overlook all the other things that need doing. The fact that these same CQ artists are maybe a little more serious-minded and a little smarter than other young fry just makes the matter that much worse.

For this reason I had a first rate lecture all wrapped up ready for Toby. I was just waiting for a chance to deliver it when he dropped in at the shack.

Now you've all known someone pretty much like Toby. His hair is blond and curly and his face is as innocent as a baby—even if he isn't. To watch him, you'd think he took life with a laugh and maybe a shrug of his shoulders, but his record on "The Hill" where he'd just finished two years toward his EE sort of belied that.

Toby was usually in hot water with most of the old timers because he'd never heard the old rule that young squirts should be seen and not heard. That, and the fact that although you'd just paid two weeks' wages for a new bottle, he'd likely pick it up as casually as though it were a head of cabbage. Then he'd probably turn it upside down and shake it while you gulped and grasped weakly at the furniture, and he'd more than likely find something loose and rattling about inside that you'd completely overlooked. This done, he'd maybe remark that the tantalum plate should have been built with at least four cooling fins, and that so and so was making them now with the grid lead out the side and knee action plate supports. He might also volunteer a bit of information about mutual conductance, space charge, and the amount of overload it would stand.

I'd never resented this characteristic, because whenever his slide-rule let him down he'd usually traipse over to my place for a bit of homespun "technology". Usually he heralded his approach with a "HEY-Y, SMITTY!" that enabled me to get the more fragile glassware out of sight and maybe run up the zipper on the high-power job. With three-thousand volts in the shack you have to be careful, especially when you can't stand the smell of burnt ham.

But this time Toby caught me flat-footed. Without so much as a word of warning he just quietly pushed open the door, dragged himself through, and slid into the nearest chair—*my* chair. And there I was with a brand new 906 laying out in plain sight. Keeping one eye on him, I started to edge my hand toward it, and then I saw it wasn't even necessary. Something was wrong with Toby. He'd seen that fourteen dollars worth of glassware, and yet he hadn't even reached for it. He just sat there, his hands in his pockets and his chin hanging on his chest.

"'S'matter?" I asked. "Sick?"

"Unh-uh." He shrugged himself deeper into my chair. "No, I'm all right—I guess."

"Just worked an FM8," I said, marking time until he got ready to unburden himself.

"I was listening," he said, without enthusiasm. "Nice signal."

"You have no idea," I said sarcastically, "how nice it is to have you just listen for a change. I was expecting that five-hundred-watt buzz-saw to smear him at any minute."

Even that didn't get a rise out of Toby.

"I guess I won't be bothering you for a while," he said.

"You don't say so! Off the air?"

Dismally, he nodded assent.

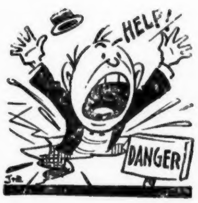
"Tube?" I asked sympathetically, remembering the color at which he ran his 35T's.

"Worse than that," he groaned, plumbing the depths of despair. "It's Dad. He says if there's any money in radio it's time I was finding it

JOHN L. MacALLISTER

YOU might be next! . . .

. . . your receiver might be the best money can buy, and your antenna okayed by the best engineers in the country, but that doesn't mean you're immune.



Don't get yourself in this guy's shoes. Be prepared for an emergency! Every ham at some time or other is troubled by a noise level so high as to make his incoming signals practically unintelligible . . . regardless of his equipment . . . so don't let it catch you unawares. With the NOISE REDUCTION HANDBOOK up your sleeve, you can be assured that the signals you want to hear won't be drowned out when you're unable to handle the situation.

The 1938 "RADIO" NOISE REDUCTION HANDBOOK is a completely different addition to RADIO'S unique library of essential information for every radioman. It tells you how to eliminate or greatly reduce practically every form of radio noise except natural static.

Particular emphasis is laid on the elimination of the noise at its source, and how to locate the source. When that is impractical, a new, highly effective modification of the noise balancing method used in commercial work can be used with almost equally good results. A complete description, theoretical and constructional, of the application of this old telephone "gag" to modern radio work is included.

When noise does get into the receiver, one of the practical noise limiters described will "work wonders" in increasing signal readability.

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out. . . . school's over. I've got to go to work. . . . No job—no radio."

"And now," I nodded in understanding, "among other things, you're a little sore at Dad."

"It's hardly fair," he admitted. "After all, I *have* been looking for a job."

That reminded me of the lecture I'd been saving up. So I unlimbered my heavy artillery. Pulling up my second best, and not so comfortable, chair I started in.

"So now," I asked sarcastically, "you're going right down and take that commercial phone exam as the first step toward making a living?" And believe me, I knew just what I was going to say when he answered in the affirmative.

"No," he replied. "As a matter of fact, I took that and the telegraph second during spring vacation. All I want now is a job. I—I thought, Smitty, maybe you could help. Maybe you know someone—"

Isn't that just like a young squirt, nonchalantly knocking off from studies long enough to go down and breeze through enough theory to—. That made the first half of my lecture totally ineffective. Gasping for breath, I floundered in somewhere near the middle.

"There's something I'm going to say to you," I began, "but first, I want to ask you two questions: Have you tried to get a broadcast job? And did you get it?"

"I did," Toby admitted, "and I didn't. They just say they don't need anyone. That's why I thought if you'd—"

"Now listen, son," I interrupted, getting a good grip on my chair, "I've never known it to fail. No sooner does a young blue-jay like yourself begin to sprout a few tail feathers than he hightails it for the RI's, gets a ticket, and then naively heads for the local broadcast station. Once in a while one of 'em gets a job. Mostly, they don't. And sometimes those that don't are the lucky ones . . . Oh, hadn't you thought of that?"

"When I like it well enough to spend ten hours a day playing with it—why shouldn't I work at it?" Toby countered.

"Now listen, Toby, I hate to admit this, but in spite of the fact that you're using hundred and twenty cycle modulation on that corn sheller of yours, and in spite of the fact that you should put at least one of the weights back on your bug, I still think you're a smart young fellow. There are probably lots of things you could make a success of. Hasn't it ever occurred to you that you might keep your hobby for just what it is: a pretty fair means of keeping out of mischief, and a better way of forgetting troubles than ever was put in bottles? Hasn't it ever occurred to you that you might keep it just as a hobby?"

"Is that why you never went into commercial radio?" he wanted to know.

"No," I told him, "I had a better reason. When I was a little kid in a country town I decided there was only one man who could eat all the ice cream he wanted—the druggist. That was thirty years ago, but I still like ice cream . . . And I can still get all the radio I want after I'm through putting up prescriptions. Now, isn't there something you've always wanted to do ever since you were a kid?"

"Uh-huh," Toby admitted brightly, "I've always wanted to be a radio operator, and if you'd—"

"I give up," I yelped, banging on the desk top 'till I happened to notice that the 906 was doing a tap dance, "I positively and definitely give up! I'll pull strings at the telephone company, or even the gas company. I'll mention your name at diathermy labs and research labs. I'll even give you the addresses of a couple geophysical labs, but I wouldn't make a radio operator out of you even if I didn't like you. There's too doggoned many of 'em now!"

It didn't worry Toby in the least.

"Okay," he said easily. "But I'm going to haunt you when I do get a job and get back on the air. Don't say I didn't give you a chance."

"Well," I told him, "if you're holding out for a commercial job, that still leaves me plenty of time to enjoy my hobby to the utmost. I'll work a few AC's and maybe a U or so, and there won't be any interference from a coffee grinder in the next block, and the young squirt who runs the bug with the greased dot lever."

"I wasn't going to mention it," Toby said simply, "but the other night I managed to contact U9EX. He came back to me, but you covered him up when he signed. Don't suppose I can get a card from him."

This gave me something to think about. I knew he'd been trying for that 17th zone for a long time.

"Why didn't you call me?" I asked. "You know I would have stood by for you."

" 'Sall right," he said. "Just part of the game. I'll hook him again after I get back on the air."

"That may be a long time, Toby," I warned him. "That is, unless you want to take a

bit of advice. . . . Of course, there's still the police station and the airport."

"I was thinking of them," he confessed.

"Remember," I said, "you've got to be a born politician to get a job at the police station—in which case you'd be wasting your talents—and as for the air lines, son, it's 35 w.p.m., eight hours a day. Takes a doggoned good op and they might require a bit of convincing. They might not think you could do it, Toby."

"Yeah," he nodded thoughtfully. "They might, at that." And then abruptly, "Well, s'long," he said, getting to his feet.

"What's the hurry? Stick around for a while and you can pound this rig if you want."

"Thanks," he said. "I'd better be getting home. Guess I'll copy commercials for a while. At least I can still use the receiver."

He left, and I guess he was feeling better because I heard him whistling as he crossed the yard.

•

It was maybe three or four days before I heard from Toby again. When I did—I was trying to pull an SM5 out of the background noise, and was doing a pretty poor job of it, too. I had both gain controls wide open and even then the SM wasn't doing much better than a whisper. That was when I heard from Toby.

Did you ever have anyone touch off a five-hundred-watt power leak right under your nose? And did you ever get the fones off your ears so quick that you couldn't rightly tell afterwards whether they'd blown off, or whether you'd just naturally jumped clear of them? Yes, the SM was gone. But something else was there, and even before I turned the gain controls to zero and the squawks subsided into a fair semblance of machine-gun dots and dashes, I knew that Toby was back on the air. He was calling his U8, and he got him, too. When he signed, I gave him a call and asked for the low down.

"VY SIMPLE," Toby came back, pulling another weight off the bug. "ES SMITTY, I OWE IT ALL TO U. REMEMBER WHAT U SED ABT AIR LINES? TNX FER TIP. I COPIED THREE 8 HR SHIFTS ON AIR LINE'S QRG ES TOOK ALONG A 24 HR RECORD WHEN I ASKED FER JOB. AM WRKNG FER AIRLINES NW. NICE WRK IF U CAN GET IT. HI! ! !"

•

And what can you do with a young twerp like that? Maybe some people are just born to be radio operators. For them at least, the answer is simple when someone says: "LITTLE HAM, WHAT NOW?"

Long Range Dx Prediction

[*Continued from Page 26*]

and of the exact peak of sunspots—which may have been last winter or may yet come in the next year or so, it cannot be said definitely that we are soon to enter the downward phase of the cycle. We *can* say that conditions are unlikely to change markedly in the next year, and comment on how things will be by 1944. At that time, presumably, solar activity will again be around its low, and 28-Mc. winter dx will be very scarce. 14 Mc., in the winter, is likely to go dead for U.S.A. work much below 2200 miles in the early evening; the Europeans who have been coming through most of the night are likely to pass out in mid-afternoon; and in the late evening the band is likely to sound completely dead, not to open up until just before sunrise. 7 Mc. may also pass out for U.S.A. work at short distances by eight o'clock in the evening, but stay open for dx at distances beyond about 1500 miles.

There is some reason to look to transmitter, receiver, and antenna design that will permit reasonably rapid change of band, including the use of "80," for a late evening rag-chew in 1944.

One very hopeful result of a long-range study of conditions is that the 28-Mc. band, out of every ten or eleven years, may be open for winter dx from as few as five years (of which three have already passed), to as many as eight years with somewhat more spotty conditions at the beginning and end of that period. This is based on what has happened since 1933, and assumes that conditions will not change for the worse much more rapidly than they improved following the last sunspot minimum.

"The Mighty Mite"

[*Continued from Page 23*]

and the condenser values are retained as recommended.

If the crystal stage oscillates at all settings, regardless of crystal frequency, increase the size of the .00035-μfd. condenser from crystal to ground. If no oscillation is found, reduce the size of this condenser. Reducing this value will aid in producing greater harmonic output, but tends to increase possibility of uncontrolled oscillations on other than crystal harmonics.

Next, plug in the 807 and allow it to warm up. Connect the coil and plate cap. Retain the meter switch in the crystal oscillator plate circuit and throw on B power. Return the crystal tank for greatest dip, then switch the meter to the 807 plate circuit. Tune final tank condenser for greatest dip. When this is accomplished, the r.f. unit may be considered working correctly. Plate current indications in this stage also include the screen current and the dip should be to about 12 ma. Trouble-shooting on the final may be accomplished, so far as coils are concerned, in a manner similar to that described for checking the oscillator.

Next, try the audio system. Remove the r.f. tubes from the set and connect a magnetic speaker across the output of the modulation transformer. Plug in a crystal pick-up or microphone, turn on the B power, throw the speech-modulator d.p.s.t. plate supply switch to the on position, and then turn up the gain.

If the circuit has been followed faithfully and good attention paid to layout, no trouble should be experienced. Of course, if the microphone and speaker are within close range of each other, audio feedback will result. If no output is forthcoming, use the usual methods of checking for trouble, such as testing plate voltages at each socket, testing tubes, etc. If found okay in all respects and working satisfactorily, remove the speaker and connect a ten-watt lamp across the output of the modulation transformer. Turn on B power and turn up the microphone gain. You should be able to turn the gain on full without lighting the lamp unless feedback or hum is present. When you have done this, speak into the microphone, and the lamp should flare up. When this test has been proven, the speech and modulator may be considered okay. Then replace the r.f. tubes and place a three- or four-turn link around the final amplifier tank coil, link-coupling it to the antenna tuning system. Tune via usual methods for greatest load, (55 to 65 ma.) and you're on the air!

An All-Wave Tuner Panel

[*Continued from Page 31*]

clearly. Below-chassis placements are similarly self-explanatory. It might simply be noted that CH_3 (the output plate choke) hangs from the chassis, that the output line transformer is supported on the right wall in horizontal position, that the one-μfd. noise diode timing capacity (the largest foil condenser shown) is positioned close to the second detector, and that the tapped voltage divider is mounted on one of two shielded r.f. chokes which in the laboratory model have been used to replace two of the i.f. plate de-coupling resistors. (Resistors or 16-mh. chokes may be employed, as an individual builder prefers.)

Construction, Wiring and Adjustments

Constructional and adjustment details are hardly necessary here; but the writer will, in closing, enumerate several recommendations which will or should facilitate duplication and assure efficient performance.

1. The chassis may be a blank one, or simply the made-up Meissner job. The stamped unit is of course well worth while, as the layout has been developed so that the utmost use of the cutouts and drillings may be made; it will simply be necessary to drill a very few extra small holes and to enlarge socket cutouts slightly (preferably by means of an Amphenol LD-1 die) for proper installation of the retainer-ring mounted socket items.

If, by the way, the completed assembly is to be rack mounted and the prepared Meissner chassis is to be used, the under lips of this chassis will very probably have to be cut back flush with the side drops, at least for three or four inches of their length.

2. Drilling layout for the chassis walls, the panel, and the supporting arms is such as to elevate the chassis slightly above bottom level for the panel after assembly, and to extend it back from this panel far enough for proper dial face clearance.

3. As the r.f. assembly or "front end" is a complete job, properly wired, the business of hookup of the r.f. circuits will be greatly simplified. Only six color-coded wires connect from the tuning unit to various receiver points or components: the blue from the mixer plate to the first i.f. transformer; the yellow from the a.v.c. network to the a.v.c. bus or line; the brown to the R_{18} gain control; the red to the high side of the voltage divider; the orange to a tap on this divider providing 100 volts for the 6K7 screen; and the white to the sensitivity or gain control R_{18}. (The latter lead, from antenna to R_{18}, may be omitted if not required.)

4. The usual precautions should be taken in wiring up the tuner. R.f. leads should be kept short. Returns for each stage should be brought to one chassis point—preferably to the number 1 terminal of the associated tube socket. Leads from the second detector to the noise switch, and the audio level potentiometer —if they are to be shielded—should be run through low capacity shield tubing, as proper noise suppression will not be effected if the rectified high frequency impulses are attenuated to ground; C_9, for a like reason, should have as small a value as possible to be consistent with good r.f. by-passing.

5. As has been indicated previously in this writing, plate voltage—with all tubes in their sockets and drawing full current —will be approximately 250 as measured at the high side of the divider. Screen voltages should be adjusted separately for each stage along this divider, until, with R_9 wide open for full tuner gain, proper limiting voltage (three volts) is measured at r.f. and i.f. tube cathodes.

6. The i.f. transformers are supplied factory peaked at 456 kc., and the r.f. assembly is supplied prealigned for proper operation at this value of i.f. It is therefore quite simple to line-up the tuner—minor adjustments alone being necessary to compensate for the capacitative effects of the wiring (particularly in the intermediate channel). Any re-alignment, of course, should be done with the acceptance switch in the position providing high selectivity.

7. As this receiver is to be used as an auxiliary job, the writer did not include an R-meter in the layout. He does not believe that the average amateur would find any such refinement necessary unless the job were to be used with a ham-band "front end" for a great deal of communications service (emergency or general). He has, however, worked in a 6G5 tuning indicator) and it is suggested that the builder include an "eye" when constructing the tuner.

●

Thus endeth this particular story. If given

layout and circuit specifications are carefully followed, or if omissions and changes are confined only to the a.v.c and a.f. circuits, any reader building this job should be able to end up with a very flexible, practical, and efficient receiver for his trouble—and at moderate cost and with surprisingly little constructional effort.

It is felt that the design will suggest more or less exact duplication and come pretty close to the ideal assembly which the amateurs who have requested circuits and layouts have had in mind. In any event, it is hoped that the thing as it stands will fill the auxiliary receiver bill. Further, it is hoped that it will recommend itself to the beginner or to anybody else who can't afford a factory receiver but who wants a switched-coil, all-service super in his shack.

Acorn-Tube 5-Meter Superhet

[Continued from Page 45]

and b.f.o. switch. All these controls are arranged in a line along the bottom of the panel. "R" meter zero adjustment is at the left of the meter and below it is mounted the silencer potentiometer and switch. The jacks for headphone and loud speaker reception are also mounted on the front panel.

R.F. and First Detector

The first r.f. stage is run wide open and the overall r.f. amplification is controlled in the second stage. The control was found necessary to prevent blocking on local signals. The r.f. section should be run wide open whenever possible and the i.f. and a.f. as low as possible. This will provide best signal-to-noise ratio.

Combination grid and plate detection was used in the first detector. The only adjustment worthy of mention is the screen voltage. Although this is not too critical, it will be worthwhile to vary this voltage for maximum sensitivity indication. Maximum sensitivity seems to occur with abnormally low screen voltage.

The only bug which gave any amount of trouble was the oscillation of the r.f. stages with the gain wide open. Before any attempt was made to remedy this difficulty, the antenna was connected and the oscillation ceased. It was later found that the trouble also disappeared when the r.f. unit shield can was completely assembled.

A 56-Mc. oscillator was thrown together and

modulated by an audio oscillator to serve as a signal generator. This greatly simplified alignment. It is suggested that alignment be attempted only over the 56- to 60-Mc. range. It will be less trying to one's patience and the receiver will still operate, although not as well, outside these limits.

To the constructor of the receiver—it is a fine job and provides r.f. gain, sensitivity, and signal-to-noise ratio of the highest order, but don't lose sight of the fact that it is only a signal amplifier and cannot amplify signals it does not receive. Therefore, give it at least half a chance with a good antenna! Your 56-Mc. transmitting antenna will probably be the best bet, especially if horizontally polarized.

56 Mc. Dx Rampant

[*Continued from Page 51*]

W8CIR was being heard in Baltimore, 250 miles away, at the same time.

In Ft. Thomas, Ky., W9WLX found W5EHM to be R9 just as W4EDD was four days before. Some fifty Cincinnati stations were calling Pat but W9WLX was successful in adding W5 to his districts worked. He heard Pat solid for the full time he was working dx. 120 watts are used in the transmitter.

Kathryn Sheffer, W9CQV, is the proud possessor of a single dx card—from W8CVQ. However, she and Joe raised W5EHM using 45 watts on a pair of T20's in a long lines oscillator, and using a superregenerative receiver.

In Oak Park, near Chicago, W9YFQ was heard by W5EEX in Houston and raised W5EHM. He uses a pair of T55's driven by an 809. The receiver is a six-tube superheterodyne, the antenna a Q-fed vertical.

In Waukegan, Ill., W9TZQ gave up traffic work on 3675 kc. because of conditions and turned to 56 Mc. for a local contact. He uses a simple 56 superregenerative detector plus audio with four feet of wire for an antenna. He said he jumped a foot on hearing W5EHM reply to W8JMS. He has a single 53 oscillator with 12 watts input, feeding a horizontal zepp running from the table across the room, end-on to Dallas. The modulator is a 2A5 capable of only 50 per cent or so. However, he raised W5EHM! It must have been stable to be received on the selective superheterodyne at W5EHM. W9TZQ heard the final fade-out at around 8:30 when W5EHM was trying to work "W8FMI", identical with the closing of the band at W5EHM.

W6EVO portable, also in Waukegan, heard both W5EHM and W5EEX.

W9SQE went down to 56 Mc. just this year, using 150 to 200 watts on a crystal-controlled T55 final, and an acorn superregenerative receiver. He successfully raised W5EHM.

Down in Peoria, W5EHM was heard by W9FST, W9YYY, W9ZOA, W9VKU, W8ADJ portable, and W9ARN. W9LLC in Pekin also heard him. W9VKU heard an unidentified station in Kentucky. W9ARN raised W5EHM with 100 watts on a 35T final, using an RME-69 with 510X expander. The antenna was a 28-Mc. V beam, 6 wavelengths on a side on "ten", pointed at England.

In Milwaukee, W9ZGD went on 28 Mc. at 5:27 p.m. Central time, finding the skip quite short. He heard W5ALK mention hearing W9ANA that morning, so shifted to "five". He writes, "The first dx I heard was W5EHM; I almost fainted when I heard that southern drawl." He made a contact, and heard Pat pass out at 8:30. Then at 8:38 he heard W5ALK on c.w. call W9FP in Chicago, followed by silence. W9ZGD mentions that the skip shortens on 14 and 28 Mc. at the same time as on 56 Mc. He uses a regular communications receiver on 28 Mc. with a 56-Mc. tank circuit between detector grid and ground, with the antenna coupled to it, leaving the oscillator on 28 Mc. and using no r.f. The transmitter is a 6L6 doubler! It takes 20 watts and feeds a vertical double-zepp.

In Fort Worth, W5ALK listened to a good share of the QSO's during the last half hour that the band was open, logging the following: W9ARN, W9YFQ, W9CQV, W9CLH, W9FP, W9ZEO, W9FP, W9CLH, W9ANA, W9SQE, W9AAV, W8RSS.

He could copy only the crystal controlled or stable oscillator signals, many broad self-excited carriers also being heard. His ordinary 28-Mc. receiver was used with the help of a stunt we have mentioned before — putting a 56-Mc. tuned circuit in the detector of the receiver. A three-plate condenser, with a four-turn one-inch-diameter coil soldered across it, was connected to the detector tube grid in place of the usual grid clip. This was tuned to 56 Mc. About four turns of insulated wire as an antenna coil was pushed into the tank coil. By tuning the receiver over the 28-Mc. range, using the second harmonic of the oscillator, 56-Mc. signals come through with surprising strength, locals being too loud for full gain. A modified rotary flat-top beam was used; the horizontal is believed to be better for dx signals. A quick attempt to double in the final in time to make some QSO's was not successful before the band folded, though he was heard in Milwaukee on c.w.

In Shreveport, La., W5FYS heard a large number of carriers but few were loud enough to over-ride the superregenerative hiss. W9ARN, W9CLH, and a Chicago station were heard. The band closed for him at 8 o'clock.

W9CX in Chicago heard Pat until 8:35, sometimes loud enough to be heard all over the house, on a Ultraskyrider. He also heard W5EEX. W5ADG in Dallas heard W9CLH and W9ANA.

A Springfield, Ohio, listener found the band open for dx that evening, according to W8PTG. W8NED said that in addition to W5EHM, the Pittsburgh stations heard a "W3MW" giving his location as Baltimore.

That evening, the ten-meter band was reported open to W5's from Chicago, just as was the 56-Mc. band.

W5EHM's Rig

Patterson at W5EHM is said to be running 400 watts input to his final. He has a 14-Mc. rhombic adjusted for 56-Mc. low-angle signals, giving 5 to 6 R's over a vertical dipole and 3 to 4 over a reflector-director arrangement, according to the meter in his receiver. The old superregenerative receivers that were used in the dx last year are now largely junked in favor of an ordinary communications receiver ar-

ranged to operate on 56 Mc. with the oscillator on 28 Mc. Signals must be R5 to R6 on the superheterodyne before they can be heard on the others.

Morning of May 27

With a premonition that dx was about due, L. J. Kramer, W9HPP, tuned over the band at 10:00 a.m. Eastern time on the 27th. He noticed a peculiar condition with a few words of voice here and there, and decided to wait for developments. At 10:30 things popped wide open to New Jersey, New York City, and the W3's in Pennsylvania. Up until 12:15 he worked the following: W3AFJ, W3GPS, W3GQS, W3EET, W2HQX, W3BZJ, W2HGE, W2FZA, W3AIR, W3GEF, and W2KLO.

Kramer noticed considerable fading, and numerous receiver squeals from dx stations. The receiver is a type 76 tube superregenerator with audio, on a vertical antenna. The transmitter uses a 210 ultra-audion oscillator with 20 watts input.

In Bristol, Pa., W3AFJ worked W9HPP, W9SQE, and heard W9ZEO. His transmitter is a long lines oscillator with a pair of 10's, 48 watts input. The antenna is 75 feet high but the ground is only 25 feet above sea level. The receiver is super-regenerative.

W3GQS in Feasterville, Pa., worked W9HPP, W9SQE and W9YLV. He heard W9VVE, W9CX, and W9ZEO. Locals heard calling the ninth district included W3AXU, W3BZJ, W3EGG, W3AFJ, and W3ARG. The receiver is a Lafayette acorn superheterodyne, the transmitter is the five- and ten-meter job described in the Taylor Tube Manual, with 100 watts input.

When he heard W9HPP, W3EET in Camden had his exciter unit on the floor for changes. The receiver just happened to be tuned to the right frequency. Quick repairs resulted in QSO's with W9HPP, W9ZEO and W9SQE. He heard W9CX. He received a card from a Chicago listener and another from W9USU in Fort Wayne, Ind. The receiver has a resistance coupled i.f.; the transmitter uses a pair of 809's in the final with 100 watts input. The antenna is two half-waves in phase.

W2HWX was in on the dx this day, too. He worked W9HPP, W9AUQ, W9ZEO, W9ZXD, and W9YLV. He heard W9SQE and W9OPW. He received a number of cards from Chicago, one from W9USU in Fort Wayne, another from Cincinnati.

In Brooklyn, W2FZA says that no W1 and W3 stations were coming through when the band was open for W8 and W9 at 11:00 to 12:15 Eastern time. Most stations were fading. He worked W9HPP and W9SQE, hearing W9QCY in Fort Wayne, W9NNI in Culver, Ind., W9ILV in Galesburg, Ill., W9OPW in Chicago, W8OJF in Dayton, W9YX and W8PPK in Cincinnati, and W8JDA in Dear-

born, Mich. He uses a 6J5 superregenerator with audio, a TNT oscillator with 100 watts into a pair of 210's feeding a vertical J antenna. He said that W2LEG and W2CBI also made dx QSO's.

In Princeton, W3AIR was trying out a new antenna when the New York stations took a funny fade up and down. A local was overheard mentioning the dx. W3AIR heard W9HPP, on the low frequency end a W5EH? (W5EHM?) at 10:50 Eastern time. Then W8OJF, W8?FE, W9HVE, and W9SQE broke through. W9ZEO came up to R9, and W9HPP was worked. W9YLV and W9VVE were logged.

W3GEF worked W9SQE and W9HPP with a short-line 809 oscillator, on a vertical antenna 30 feet up. The receiver is an acorn superregenerator. He also heard W9OPW.

W2KLO worked W9HPP and heard W9QCY, W9ZXD and W8OJF. A pair of 210's in a TNT oscillator with 50 watts input were used on a vertical antenna.

In Chicago, W9SQE was working W8OKC in western Pennsylvania on 28 Mc. when it was suggested that the short skip might bring in five-meter signals. A call on "five" brought a reply from a W3 and the W8 was forgotten! Among those worked or heard were W3GQS, W3EET, W2HWX, W2FZA, W3GEF, W2HGE, W2KLO, W3AIR, W3BZJ, W3AFJ and W3GPS.

W9ZXD raised W2HWX and heard W3GEF using a type 56 in a superregenerator plus audio, and 30 watts into a '10 oscillator.

W9AUQ was using a transceiver with five watts input when he worked W2HWX. He heard W3EET, W3AIR, W2HJE, W3GQX (W3GQS?) and W2FBA, all on the low frequency end. His antenna is mounted on the side of the house, single wire fed. He noticed a peculiar decrease in local signal strengths during the dx.

W9ZCN noticed short skip on 14 Mc. and shifted to five meters. There, he heard W3AIR and W3GEF. W2HWX and the local W9CX were on the same frequency and would alternately fade in and out. W2KLO and W2HGE were also logged. He used an old b.c.l. receiving antenna at the time!

W9VVE said that the dx came in for a few minutes at 8:00 a.m. Eastern time but didn't get good until ten o'clock when W3EET, W2HFF, W2HWX, W3GQX (W3GQS?), W3FZA, W3EZO, W3AIR, W2HGE and W3GPS were heard.

W9CX heard W2HWX, W3EEF and W3AIR on his Ultraskyrider.

W9YLV worked some of the dx, using a 6C5 superregenerator, and a 6E6 in a unity coupled oscillator with 30 watts input.

W9QDA in Chicago did not listen during the dx but a few minutes later noticed that Ohio and Pennsylvania stations were coming through on very short 28-Mc. skip.

At 10 a.m. Central time, W5ALK heard a weak carrier on "five" and found K4FKC on ten at half the frequency. During a QSO, however, he could no longer hear the supposed harmonic.

W1KTV heard W9ANA for 25 minutes starting at 8:48 Eastern time, while reading his QSL card for the May 19th reception! W1KTV uses a superregenerator with separate quench oscillator.

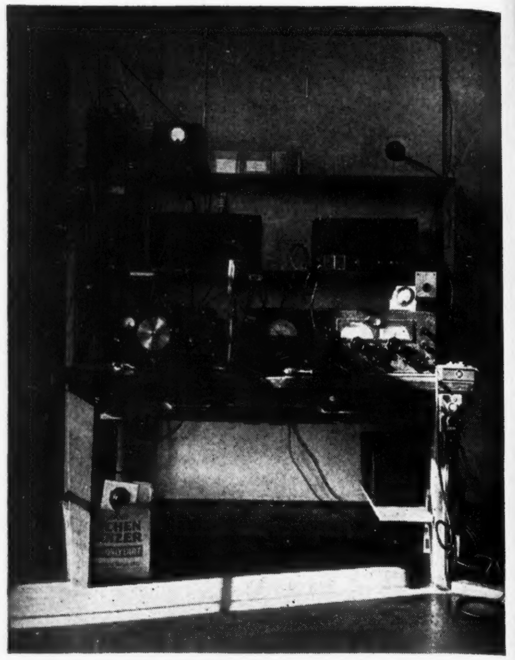
Afternoon of May 27

At 4:50 p.m. Central time, W5EHM started working the following: W8EUK, W8EGQ, W8QXV, W9UAQ, W9YFO, W8YX, W9CLH, W8QKI, W8CIR, W8QDU and, at 7:30, W9ANA. He said that W8CIR worked W5KI in Houston; and some station was calling W5AKI.

W9HPP reported W5EHM. W9ZCN heard W5EHM, W5EE? (probably W5EEX) and mentions a W2EY?.

May 30

Between 12:55 and 2:10 p.m. Central time on May 30, W5EHM worked W8QDU, W8PZU, W8QXV, W9CQV, W9ANA, W9ZGD, W9HPP, W8NFE, also hearing W9UKD and W9NWN. Between 7:00 and 7:25 he heard W4EZQ, W4EMM, W4FAP and W4EEV.



Receiving positions of W9CLH, showing both the Ultraskyrider and the RME with u.h.f. expander. Looks like the old receiver in the waste basket. At Elgin, Illinois.

May 31

From 11:50 a.m. to 1:26 p.m. Central time on the 31st, W5EHM raised W9RBK, W9DNW, W8RBA, W8YX, W8OJF, W9QEI, W9JPD, W9ZUL, W4EMM (believed to have been a W8 playing tricks), W9ANA, W9NY, the latter two being on c.w. He also heard W8OPO and W8CIR.

W9NY is now using 300 watts on a pair of T40's in the final, with a converter in front of his regular superheterodyne. His antenna is a vertical double-zepp type.

At 6:30 p.m. Eastern time, while driving in his car and listening on a five-tube superregenerator, W1EYM again heard W4EDD in Coral Gables, working a W4 in Ft. Lauderdale (W4DRZ?). He was R8. W3EZM overheard that W1KTH heard Robbie but did not know of any reception by Pennsylvania stations. W3AIR also mentioned that W4EDD had come through again. That was a particularly good night for "long local" reception for W3AIR who worked stations in Massachusetts,

Connecticut, Maryland, and Washington, D.C. He heard W3FKF in Virginia, W3HI in Baltimore, and a whole list of W1's up to 4:30 a.m. June 1.

June 1

Patterson, W5EHM, was at it again from 11:35 a.m. to 12:45 p.m. Central time on June 1, working W8CIR, W8OPO, W8QMZ, W8EUK, W9RBK, W9DNW, W8RVT, W8KG, W8JLQ, and W8NKJ. He heard W4EEV's 28-Mc. harmonic R9 at 10:30 a.m.

Other Days

The 56-Mc. band has apparently been open on a number of other days. W2JCY says that W1CLD heard W4EDD about March 15 at full moon, and W2JCY heard him in the middle of April, two days after full moon.

On April 22, W5EHM reported harmonics of W6KZR, W6LUV, and W6NWH. On May 9, he heard the third harmonic of W8XK and was reported in Pennsylvania twice, as we mentioned in the last issue.

On May 11, W9ZGD heard a W2 call a W3 but didn't get any calls, about 5 p.m. Central time. An hour later, W8CIR heard W9ANA's tape transmission and worked a "local dx", W8PK near Rochester, N.Y., about 200 miles. At that time, W8PK had noticed the 14-Mc. band change from fading Europeans to a quickly shortening skip for W8's and W2's in two hours. This same condition had been noticed in Pittsburgh.

W5EHM had a 5-10 cross band contact with W8KAY on May 13. On the 16th, W8KAY reported his signals rather weak. On the 29th, Pat heard W4FAT and W4EMV at 12:25 p.m., mentioning that on 28 Mc. he heard a more northern station working W4EDD but the skip was north and Robbie couldn't be heard.

W5AJG in Dallas heard W9ANA, W9BHG and W9UHJ on the 23rd around 8:45 p.m. Central time.

On Thursday evening, May 26, W1KTV and W1KXK were in Portsmouth, N. H., testing the latter's superhet. W8NKJ in Detroit and W1JUJ in Sanford, Maine, were overheard in a 100 per cent QSO. W1KEX and W8NKJ heard each other but did not make a contact. W1ENY and W1GIJ also heard W8NKJ.

W5EHM and many others have noticed the connection between the ten-meter band and five-meter dx at 500 to 1200 miles. Almost always, "ten" is open in the same direction, sometimes with much shorter skip.

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POSTSCRIPT

After writing ten thousand words on the subject of 56 Mc. dx, we thought it was time to go to press. But the way mail is pour ng in, with W9CLH working 32 dx stations although not getting on the air until ten hours after the band opened, with W3AIR logging fifty-one stations in seven districts in one day, we can't resist unburying the dead—line.

W6DNS gives us some more about May 12. He tells about contacting W7AQJ, and says that at 6:45 p.m. Pacific time, he was quite sure that he heard a K6 but due to heavy QRM and weak signal strength, he was unable to get the complete call. He seemed to be exactly on 60 Mc. W7AQJ was heard working dx until after seven o'clock though W6OIN reported hearing him as late as 8:20. Other W7's were coming in but with about 36 bootleg stations on the air locally, the dx situation was bad. W6DNS uses an HK54 concentric oscillator driving a pair of them in the final with 1200 volts, 170 watts input. The transmitter is on the roof. The antenna is a co-linear array of three half-waves, with directors spaced one-tenth wave. The receiver is superregenerative, with r.f. ahead, and a separate quench.

W6KFE, previously mentioned, was not on "five." It must have been someone else.

From W6IOJ we hear that he worked W7ABZ as well as W7AQJ on May 12. He has been doing a lot of work with San Diego, 125 miles away. The transmitter has an HK54 in the final with 150 watts input, modulated with an audio oscillator. The antenna is a vertical double-zepp. The receiver is a nine tube superheterodyne with 1600-kc. i.f. transformers, every consideration being given for weak signal response, using fixed-mu tubes, keeping the coils in the clear, etc. A watch is kept on 28 Mc. for short skip to indicate possible dx on "five."

W6AVR says that the dx signals on May 12 sometimes had a bad echo effect, and from periodical fades would increase nearly enough to block the receiver. He has mountains 4000 feet at the low point to the north and east! He raised W7AQJ several times, also hearing W7ABZ and W7ERA. He overheard them calling K7AMM. His final has push-pull RK11's with 100 watts input. The receiver is a superregenerator with 6D6 r.f. stage.

In Cadillac, Michigan, W8RYJ is trying to stir up 56-Mc. interest. On May 30, just before 3 p.m. Eastern time, he heard W5EHM. W8PLC had been listening on 28 Mc., hearing W5EHM call "CQ DX 5," and told W8RYJ to get down there. On June 2, he heard an R9 carrier with no modulation and slow fading, about 2:30 p.m. It was not a local harmonic. He says that he heard W5DYH and W5FVE last summer when in Akron. He uses a superregenerator.

Frank South, W3AIR, says that the band was open again on June 2. W3GQS worked W8JIN in Cincinnati at 1:30 p.m. Eastern time, R8 both ways. He also worked W8QMZ. The band closed at 1:52. Fading was as pronounced as on May 27.

W3ATR in Philadelphia reviews recent local dx. On May 26, he heard W9ANA at 3:34 p.m. Eastern time. On May 27, he heard W9SQE at 11:35 a.m., several W9's and possibly a W4 but fading was too much for him. At the same time, Detroit stations were coming through on ten meters. On June 2, he missed the dx but heard suburban stations calling W8's in Ohio around 2 p.m. On June 5, he heard W9NY in Milwaukee on c.w. during a contact with W3BZJ at 10:20 a.m., fading out at 10:31. Most reception was done on a superregenerative receiver except that of W9NY which was on an SX16 Skyrider. W9SQE's voice came through on the superheterodyne after becoming inaudible on the other receiver. He says that 28 Mc. seems to be a good marker, with 400- to 600-mile short skip whenever the five-meter band is open.

June 5

The biggest five-meter dx day in history was June 5. Every district east of the Rockies participated in an all-day Sunday frolic. Even the VE1 and VE3 boys had a chance.

W8NED says that the band opened in Pittsburgh at 10:30 a.m. Eastern time with the third district coming through weak. One was heard saying he was in New Jersey, and a W2 signed from New York City. W2GAH was heard for six minutes. Then the first district came through with a great many W1's heard. W8CIR worked W2GAH, W1QV and W1IVA; and W8NED worked W1BJE and W1IZY. The band went out at 11 a.m. but throughout the afternoon stations were heard fading in and out rapidly. The whole Pittsburgh gang was lined up in the afternoon but

nothing happened until 5:45 p.m. when signals were swishing in and out too quickly for a QSO. W8VO in Akron was heard calling W1 and W9, and W8CIR heard somebody calling G5ML (W5ML?). At 5:45, W8MST heard W4EDD for a minute or two. At 5:50, W8CIR worked W2KLZ, before the east coast went out for good. From 5:45 to 6 p.m. the first, second, fifth and ninth districts were all coming through but all with a rapid and deep fade.

At seven o'clock, the W9's started to come through strong and steady, with W9ZJB in Kansas City outstanding with his 9x c.w. signal, sometimes the only W9 coming in. As the evening progressed, more ninth district stations were heard and worked. At 8:17, W9GKO in Duluth, Minnesota, was heard R9, testing for reports, but had no receiver on the band.

Things slowed up around 8:30, until 8:55 when W5's started to come in. "W5FZ" was heard, also W5ZS in Shreveport, W5ETQ and W5AHZ. At 9:45, the nines started in again with the fives lasting until 10:45 and the nines until 11:23. During the morning, W8NED heard a c.w. harmonic of WDS.

An incomplete list of stations worked follows: W8CIR: W2GAH, W1QV, W1IVA, W9ZJB, W9AHZ, W9UIZ, W5ETQ, W9WTV, W2KLZ.

W8CLS: W5ZS, W9AHZ.

W8MST: W9ZJB, W5ETQ.

W8NED: W1BJE, W1IZY, W9ZJB, W5ZS.

W8VO: Reported he had worked four W1's, one W2, two W5's, one VE3, also hearing 21 first district stations and a VE1.

Heard in Pittsburgh area: W1JUN, W1IXB (W1IXP), W1IJG, W1QV, W1IVA, W1BJE, W1IZY, W2GAH, W2IXY, W2KLZ, W3FZE, W4EDD, W5ZS, W5ETQ, W9AHZ, W9OLY, W9KDY, W9WWD, W9WTV, W9MOW, W9ZJB, W9GKO, W9FD, (W9FP?), W9QVP, W9UIZ, WDS.

W8CIR now has seven districts worked, needing only the two west coast districts, tying with W2JCY and W5EHM. W4EDD at last report had a cross-band with W5EHM, but no W9-W6-W7.

In Elgin, west of Chicago, W9CLH is on the air every evening, and will continue this schedule throughout the summer. He missed the morning dx but between 6:30 and 9:00 p.m. Eastern time on June 5 worked the following 32 stations: W1JNT, W1KGE, W2LAH, W1IZY, W1SI, W2KBG, W1KUM, W3ERA, W2KHR, W1JLI, W1KOE, W2BB, W2HYJ, W1IXO, W2FQM, W1JXM, W2MO, W2LP, W2FBY, W3VY, W3VYF, W2JCY, W2FBI, W2KNV, W1IUI, W1KTF, W2BHD, W2ISY, W2KLV, W3AYF, W8AGU, W3FVR, W1JIT, W2KYY, W2KOU, W2IXY, W2LEY.

QRM was terrific and some QSO's were not completed. In fact, it is doubtful if ten per cent of the stations calling W9CLH were actually worked, and if contacts were had with as much as one per cent of those coming through. Many east coast stations were heard calling a North Dakota station, also believed heard at W9CLH, but the call was not copied in the QRM. The New York gang said that the opening of the band was preceded by a severe storm, which held true in Florida on May 15, and in Chicago on May 19 and 27 when the band opened to W5EHM and W5EEX. However, it has been a wet month.

W9PQH in Batavia made 21 contacts before he left the air. W9ARN in Peoria, W9NY in Milwaukee and W9LNV were among the stations being called by the dx.

At around 10 a.m. June 5, W9SQE in Chicago worked W1IXP and W1DEI, noting that the band alternated between W2 and W1 stations. His wife made him quit working the dx. On the previous day, he had heard a W1, and syllables of voice on the band, while 28 Mc. was wide open to the east; but good five-meter signals did not quite develop.

W9ARN in Peoria says that things opened

up on June 5 at 9:45 Eastern time in the morning, and he worked W2DMM, W1EYM, W1IJG, W1IXP, and W1KUD, hearing W1HM, W1DEI, W1KIB and many self-excited jobs too hard to read on the 510X expander. The band closed at 11:00 a.m. During this time, W9LLC in Pekin worked W1EYM, W1IGJ, W2GAH and heard W1DEI, W1KIB, W1IXP and W1IZY. At 5 p.m. things opened again but W9ARN didn't come on until an hour later, then contacting W1JXN, W1KLZ, W1JQO, W1KEE, W1JZN, W1KXK, W1IUI, WIMJ and W2HWX, also hearing W8AGU, W1JLI, W2JMC and W2KLW before the band closed at 9 p.m. During this time, W9TMM in East Peoria worked about a dozen east coast stations. In a half hour, W9LLC at Pekin worked W2MO, W1JQA, and W3GEF. About 11 p.m. W5ZF (probably W5ZS) was heard. The outstanding signal was W1KEE, as good as the best on 14 or 28 Mc., putting the R meter across the scale at times. On the superheterodyne, crystal-controlled signals came through clearly but the self-excited rigs caused a lot of QRM. Sometimes four or five modulated oscillators, not adjusted for small frequency modulation, would call W9ARN at once but he was lucky if he could identify one out of the bunch. He suggests a calls heard list for 56 Mc.

In Kansas City, W9ZJB appears to be the outstanding station in the recent dx. The band was open from 5:00 to 11:15 p.m. Eastern time. He worked W2HWX, W2ISY, W8AGU, W8CIR, W8GU, W8DSU (straight c.w. both ways—first R.S.G.B. contest score reported to us), W8MST, W8NED. He heard W3FOP and W3FVH calling W8RVC; W3EZM calling W8WEN; W3FBH calling W8EVC; W1KEE calling W9QCY; W1SI, W2KLV, W1GDJ, W3FVR, W1JNT and W2HGB calling W9CLH; W2MO calling W8CRV; W8QDU calling W5AJG; W2JCY calling W9TI or W9CI; and W2GJK, W1JQA, W1JNC, W1JMT, W2DYR, W2JMC, W3CUD, W3VX, and W3HKM calling CQ. W9ZJB was using a two-tube superregenerative receiver, 6C5 and 6L6; and a crystal controlled transmitter with 120 watts into a pair of T20's in the final, not modulated.

Herb Wareing, W9NY, has been working W9CLH from Milwaukee quite often. He heard the band open to the east coast on May 27 at 7:45 a.m. Central time for an hour, and to W5 that night for a few minutes at 5:30 and 7:30 p.m. On May 31, it was open to W5 again at 1:30 p.m. But Sunday, June 5th, it really opened wide starting at 9 o'clock in the morning to W8, drifting to the east coast, for two and a half hours. It opened again between 4:40 and 8:06 p.m. starting at the east coast and drifting somewhat closer. It opened again from 9:45 to 11:40 p.m. to W5. On the three days, the following were worked on straight c.w.: W1BJE, W1CSR, W1EYM, W1IZY, W1KAD, W1KTF, W2BVY, W3AIR, W3BYF, W3BZJ, W3CXU, W3EVT, W3FVR, W5AJG, W5EHM, W5ZS, W8CLH.

The following were heard, all stable signals: W1IXP, W1KEX, W1SI, W5CSU-1, W2DYR, W2FQM, W2GAH, W2HYJ, W2IXY, W2JCY, W2KBG, W2KFG, W2KHR, W2KTC, W2KTU, W3CUD, W3DOD, W3FAA, W3FSI, W3GHY, W3GIO, W3GKW, W3GMZ, W3HG, W3HJX, W3HJT, W3HKM, W3VX, W5ML (is that the G5ML somebody called?), a W8 and WDS.

W9NY was not logging calls but looking for those who could copy his c.w. on 56.012 Mc. The band was solid with crystal controlled signals from 56 to 58 Mc., all that his receiver covers. Modulated oscillator phones did not make as much QRM as expected. Some were there, but it was just a little more background noise, and the crystal signals covered them completely! His receiver, using an acorn converter ahead of a regular superheterodyne, is sharp enough to cut through the broad signals. Wareing says we need more c.w. signals and good receivers.

Another Milwaukee station, W9ZGD, was in on things on June 5. He heard the short skip on 28 Mc. and went down to "five" in the afternoon, working five W1's, seven W2's, and four W3's. His rig has been described previously. After 8:05 p.m. Central time he went back to 28 Mc. until Minneapolis was heard at 10 p.m., when W5ZS came in on 56 Mc. On June 6, he says that at 5:17 p.m., one station in Bridgewater and one unidentified signal were heard. On 28 Mc., W2JCY said that he had been heard in South Africa, South America and fourteen times in Europe, on five meters!

In Brentwood, Pa., W8RUE heard W5ZS and W5EZR working each other at 6:00 p.m. Eastern time; W9AHZ in Kansas City; W9Q?? in Duluth, Minn.; W5ETQ mobile in Tulsa, Okla.; W5AJG calling W8GU; and W9OLY in Des Moines working W3FZR at 10:50.

In Shreveport, W5FYS heard W8QDU at 6:35 p.m. Central time on June 5, calling

W2IMH and working W3AIF. Covington says he is shifting his superheterodyne to "five" using the 28-Mc. oscillator coil, and hopes to hear more of the dx.

W1JIS in Rockland, Mass., says W9CLH blocked his receiver on June 5. In the bedlam from six until after nine o'clock, he logged these: W8OIA, W9ZSS, W8RVT, W8EGQ, W8YX, W9HG, W9CLH, W9FP, W9ALE, W8RSS, W9LLC, W9ARN, W9QZY, W9CX, W9PQH, W9ZDE, W9IXQ (?), W9LYI, W9HPP, W8ELP.

He also gives this list for W1SS: W9PQH, W9SZZ, W9BNN, (W9TMM?), W9CH, W8QXV, W8YUT, W9ARN, W8RVT, W8RSS, W8AZZ, W8JIN, W9CLH, W5DRN (Wichita Falls, Texas), W9LZZ, W9IVC, W9YSU, W9FER, W8CAS, W8LGT, W9VHJ, W8BTC, W8IUD, W8EGO, W8KTB, W9FEN, W9ALE.

Also, he mentions 5DRN and W4EDD heard by W1SS on the evening of June 7, but his letter is postmarked that morning. Possibly this was June 6.

W1AZW went up to Monument Mt. at 7:30 p.m. Eastern time and reported W9LNV (Chicago), W8RSS in Cincinnati calling W2JMP, W9TMM on i.c.w. calling W1SS. Then the old reliable, W9CLH, was heard R8 working W1, W2 and W3. W9ARN in Peoria was loud for a while, but didn't stay in long. The last was W9TMM working W2JLK, saying he had 40 watts on a pair of 801's in the final. The band closed at 9 o'clock standard time.

J. F. Brewster, W1JQA, says that things opened at 11 a.m. (apparently Eastern daylight time) but he came on at 6:30 p.m. to work W8RSS, W9LZL, W9ZSS, W9LLC, W9CLH and W9PQH, also hearing W9ARN, W9QDY (QCY?), W9ALE, W9FP, W8EGQ, W8RVT, W8YX. The band closed at 9:45 p.m.

Near Detroit, W8PPU noticed the band open shortly before 10:30 a.m. Eastern time, best between 57 and 60 Mc. for the first forty-five minutes, then until noon, better below 57 Mc. He is not sure of all the calls but reports these: W2DB, W2VKL, W2GAH, W2ITE, W2JCY, W1KMN, W1EYM, W1KPN, W1HM, W1KJT, W1DEI (best signal), W1AQM, W1IZY, W1KIB, W1LBK, W1NFX, W1EKT, W1IYT.

In Chicago, W9YSV missed the May 27 morning dx by calling on some other stations. He got home in time to work W5EHM in the evening, also hearing W5ZS. On June 5th, starting at 10 a.m., he worked W2HWX, W2MO, W1KNN, W2JMC, W2DB, W2JUN, W2JCY (who was working them in lots, wholesale), W2KHR, W1KGA, W1JLI and W1HXE. He says he heard W1KUD, W1JSR, W1KTF, W1JQN, W1KIZ, W1GPE, W1DEI, W1JFK, W1DPP, W1IZY, W1LBK, W2IYT, W1KMY, W1IAH, W1JQO, W1IJ, W1JUJ, W3FCN, W2GAH.

The best list of calls heard—fifty-one—came from W3AIR who listened from 7:30 to 11:59 Eastern daylight time. He worked W9NY who was using c.w. (and what a punch!). His calls heard include W7EYN (the last letter questionable—who was this?) and these: W5ML, W5ZS, W7EYN?, W8NU, W8NKJ, W8OTG, W8LSS, W8RRH, W8QDU, W8JLQ, W8RKD, W8AGU, W8WEN, W8RSS, W8OIA, W8RYT, W9BEA, W9ARN, W9MXK, W9USH, W9JVE, W9YRC, W9AHZ, W9LRY, W9LVX, W9YMD, W9NY, W9YFZ, W9CLH, W9YMG, W9FEN, W9UTS, W9ZJB, W9FT (W9FP?), W9PQH, W9LZN, W9YSV, W9YGC, W9ALE, W9ZSS, W9LNV, W9TMM, W9CX, W9LVK, W9EGV, W9LZL, W9OVK, W9CPX, W9GGH, W9ZGD, W9ZB (W9ZD?).

In Dallas, W5AJG heard W9ISM at 4:48 Central time and W8SSW (?) at 5:25 on June 1. On the 5th, he worked W8VO, W8NP,

W8QKI, W8JLQ, W8QDU, (the only phone) and W9NY, the last R9 plus on straight c.w., all between 9:27 and 10:15 p.m. W8CIR was heard at 9:18, and W8OPO a little later. May noticed an absence of fading this year, with more c.w. work.

W8IPD sent us a card from Lake Placid where he was looking over the expedition possibilities. We bet he was sore about having missed all the dx at home!

SM5SN is running continuously, tone modulated, at frequencies between 56.0 and 57.5 Mc., crystal controlled. Transmissions may run for at least this year, with a probable interruption from June 25 to July 18.

W9USI in Brookings, South Dakota, heard W8RVB at 11:15 a.m. Central time on May 19.

The Milwaukee club and the A.R.R.L. offer a cup for 2000-mile work between continents. California to Hawaii should be a cinch.

Acknowledgement

We wish to thank the many stations who reported the details to us so completely. We shall be glad to receive reports throughout the summer, addressed to E. H. Conklin, Associate Editor of RADIO, Wheaton, Ill., so that we can bring you a complete review of the summer dx in the October issue, out about September 15.

The Dx Bandhopper

[*Continued from Page 11*]

ings, and the grid turns are interwound between the plate turns of the 10-meter coil in order to get sufficient coupling without resorting to a large number of pickup turns.

Tuning Up

The first thing to do is to tune the oscillator for maximum output, with the 1000-volt supply disconnected. Then, one at a time, tune the doublers for minimum plate current after throwing the switch to the corresponding position. Next, slight readjustment is made of the settings of the three midget condensers until approximately the same grid current to the TZ-40 is available on all three bands, without worrying too much about the actual number of milliamperes being pulled by the 6L6-G's. Be careful not to hit the third harmonic of the oscillator.

The TZ-40 stage is then neutralized in the conventional manner, with the 20-meter coil in service. The neutralization adjustment is correct when no jump in grid current is noticed as the TZ-40 plate tank condenser is swung through resonance from a few degrees either side. When neutralized on 20 meters, the adjustment will hold sufficiently close for 10 and 40 meters, and no readjustment of the neutralizing condenser is required when changing bands.

When the high voltage is applied to the TZ-40, the grid current will drop somewhat, but it should still be at least 20 ma., preferably 25 or so. With less than 20-ma. grid current, the efficiency of the TZ-40 stage begins to suffer.

The cathode current should run around 50 ma. for the oscillator and approximately 70-85 ma. for the doublers. It should be borne in mind that this is the combined plate and grid current, and not just the plate current; hence the high reading for the high-μ triode doublers. For good tube life, the plate current to the TZ-40 should run around 125 ma., and should not exceed 135 ma.

56 Megacycles

[*Continued from Page 68*]

a tuned circuit, may be an improvement. An acorn tube r.f. stage also should help. This is all rather makeshift, but often the results are better than on a superregenerative receiver.

A lesson in the use of sharper receivers is provided by Frank Lester, W2AMJ:

"Incidentally, you might urge the construction of receivers that are as sharp as they would be on other bands, for five meters, rather than continue with comparatively broad tuned jobs merely for the sake of the modulated oscillator. I am not trying to be high hat, but making this suggestion with a view toward improving five-meter reception as well as transmission. I am sure I will be backed up by any of the boys who are using crystal controlled rigs with a fairly decent receiver. Such receivers will, of

course, make it impossible for one to work a modulated oscillator (if it is severely frequency-modulated—Ed.). However, at the same time this is liable to give the still large majority of modulated oscillator users sufficient stimulation to go to crystal control, and then to build a selective superhet. I can assure you that this will go a long way toward making five-meter dx contacts more numerous, as well as improving all local five-meter communication.

"Since using the receiver set-up I have mentioned previously, it has really made five meters a different band for me. I can work the first and third districts any night now, with the second district going full blast. I merely mention that the antenna I am using is a simple Q about 50 feet off the ground, which is used for both transmission and reception."

A further lesson was provided by W4EDD whose dx contacts were severely limited by the broad resistance coupled i.f. in his receiver, making it necessary to try for only the loudest signals.

And finally, there is W5EHM who points out that R5 to 6 signals on the ham-band superheterodyne are necessary before they are audible on a *good* superregenerator. He makes no attempt to copy any but the more stable transmitters—but works gobs of stations!

Transmitters

Getting a crystal-controlled transmitter to work properly does not seem to be as hard a job as antennas and receivers, for the "soup" in the antenna is measured easily. We note that the A.R.R.L. has decided to have a poll among league members or amateurs in general on extending the stability requirements to include the five-meter band. We don't know how it will be worded. We note, however, that Section 381 of the F.C.C. rules, on prevention of interference, can be interpreted two ways depending on whether the clause, "below 30,000 kilocycles" is applied to the sentence in which it appears, or to the whole section. In the former case, overmodulation is illegal even on 56 Mc. And that means modulation in excess of modulation *capability,* which may be below 50 per cent for some transmitters, particularly oscillators. Some modulated oscillators were copied on selective superheterodynes in the recent dx, and may have been adjusted as to be comparatively free from frequency modulation. Commercial practice does not seem to require a buffer between a self-excited oscillator and a modulated amplifier, but the oscillator generally is concentric line controlled.

Section 382 prohibits i.c.w. below 30 Mc., requires "adequately filtered" d.c., and minimized frequency modulation. If the frequency modulation on 56 Mc. is controlled by proper adjustment of the transmitter, it doesn't appear to follow that i.c.w. should be prohibited. The only objection to i.c.w. we have heard was on the part of a superregenerative receiver user whose trouble probably would not have occurred with a superheterodyne. On dx, i.c.w. may reduce fading compared with unmodulated c.w.

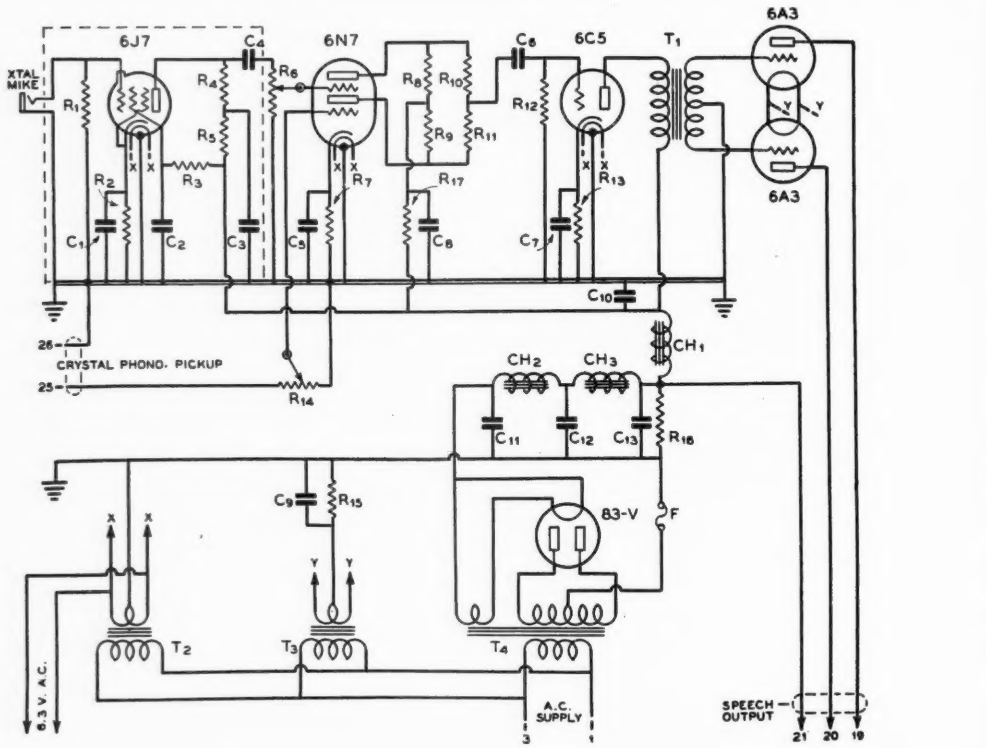
Antennas

As far as dx beyond 500 miles is concerned, the tests in May reasonably well proved that there isn't much difference between verticals and horizontals, other things remaining equal. Of course, an antenna with more gain at the useful angles between *two* and *ten* degrees above the horizon should be superior to one of lower gain, regardless of its polarization. Fading may be different on the horizontals compared with verticals. If the antenna is high enough to have a null below ten degrees, it will be "blind" to signals arriving at the angle

[*Continued on Page 98*]

CHASSIS E FIRST SECTION

SPEECH AMPLIFIER AND POWER SUPPLY



C_1—10-μfd. 25-volt elect.
C_2—.05-μfd. 400-volt tubular
C_3—1.0-μfd. 400-volt tubular
C_4—.005-μfd. 400-volt tubular
C_5—10-μfd. 25-volt elect.
C_6—.05-μfd. 400-volt tubular
C_7—10-μfd. 25-volt tubular
C_8—1.0-μfd. 400-volt tubular
C_9—10-μfd. 100-volt elect.
C_{10}, C_{11}, C_{12}, C_{13}—8-μfd. 450-volt electrolytics
R_1—3 megohms, ½ watt
R_2—1600 ohms, 1 watt
R_3—1 megohm, 1 watt
R_4—250,000 ohms, 1 watt
R_5—100,000 ohms, 1 watt
R_6—500,000-ohm potentiometer
R_7—2500 ohms, 1 watt
R_8—250,000 ohms, 1 watt
R_9—250,000 ohms, 1 watt
R_{10}, R_{11}—100,000 ohms, 1 watt
R_{12}—500,000 ohms, 1 watt
R_{13}—2000 ohms, 1 watt
R_{14}—1 megohm potentiometer
R_{15}—1500 ohms, 25 watts
R_{16}—50,000 ohms, 5 watts
R_{17}—100,000 ohms, 2 watts
T_1—6C5-to-p.p. 6A3-grid trans.
T_2—6.3-volt 5-amp. fil. trans.
T_3—6.3-volt 4-amp. fil. trans.
T_4—750 v. c.t., 125 ma.; 5 v., 2 a.
T_5—P.p. 6A3 plates to speaker line
CH_1—20-hy. 50-ma. filter choke
CH_2, CH_3—15-hy. 125-ma. chokes
F—250-ma. Littelfuse

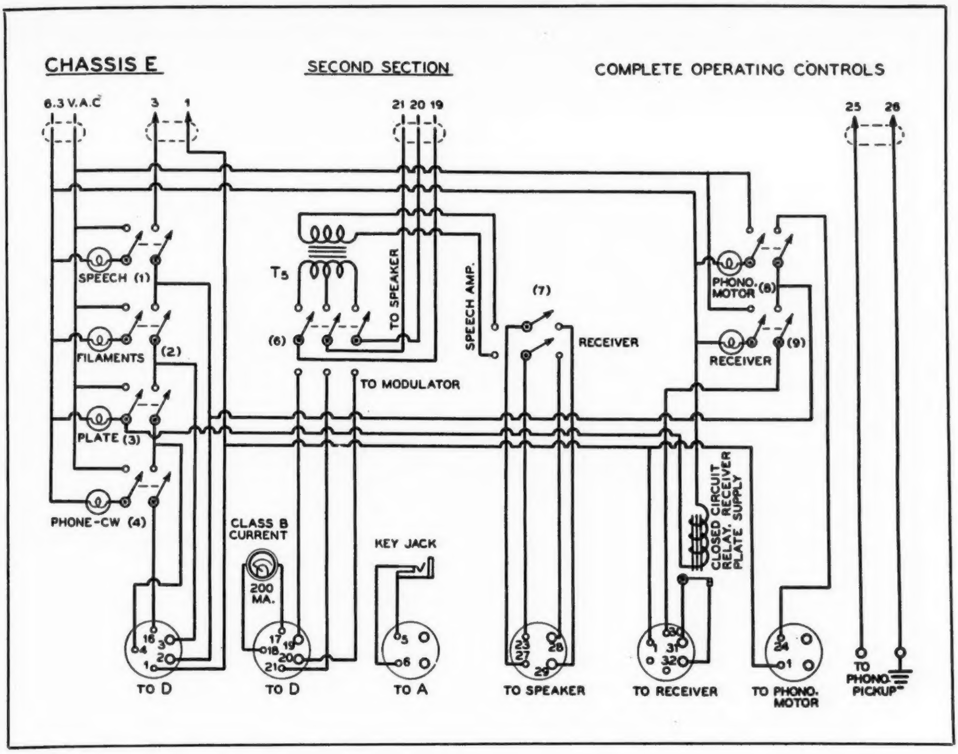
Streamlined is the Word

[*Continued from Page 56*]

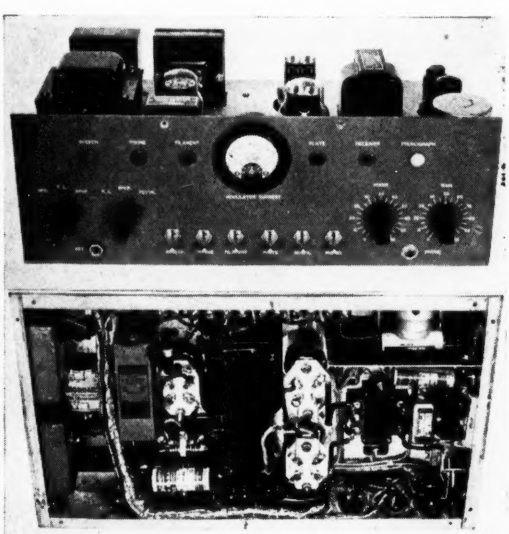
amplifier panel, which is directly in front of the operator. The meter shunt, however, has been left in the modulator chassis, so that the connecting leads 17 and 18 do not carry around high voltage.

Nothing much need be said about chassis C which holds plate and grid supplies for the final amplifier. The a.c. input has been filtered for r.f. A high-voltage fuse and primary safety switch have been provided here, as in all the other power supplies of the rig. Safety is inexpensive and highly desirable. The chassis is 10"x12"x3", and fits neatly into its space in the lower right-hand corner (rear view).

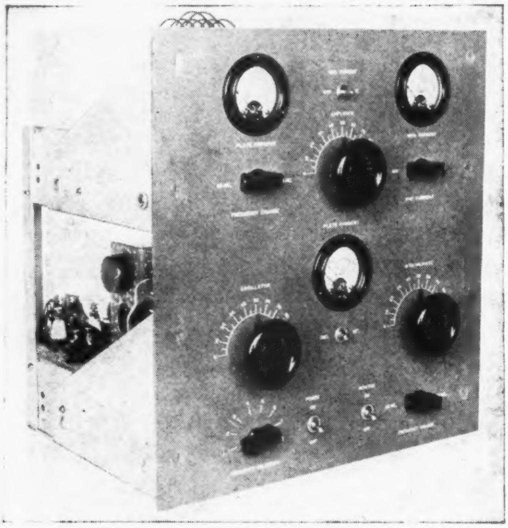
Chassis E has the speech amplifier and associated power supply and the nerves of the apparatus. All controls except tuning are centered here. The chassis is 17"x9"x3", the front panel 19½"x5½". A crystal mike feeds into a 6J7, which in turn feeds into the grid of one triode of a 6N7. Input from the crystal phono pick-up down in the bottom drawer is on the grid of the other triode. The 6N7 functions as a mixer, separate gain controls being provided. It then drives a 6C5 which in turn drives a pair of push-pull 6A3's. The output from the 6A3's is controlled by switch 6, which throws it either to the modulator or to the speaker. Either or both speech and recordings may be fed to the speaker, since the speech amplifier is controlled separately by switch 1. Switch 8 controls phono motor. Remaining switches are:



Switch 2 controls the transmitter and modulator filaments. Switch 3 controls the transmitter and modulator plates, and remains open until 2 is closed. Switch 4 cuts the primaries of the modulator power supply onto switches 2 and 3 above. The final stage plate lead runs permanently through the modulation transformer secondary; hence all that is needed for phone operation is to close switch 4, whereafter the modulator plate and filaments are controlled by 2 and 3. The remaining switch, 9, controls the receiver. The relay R_y, as mentioned before, is the receiver stand-by control.



Top and bottom views of the speech amplifier chassis.



Front ¾ view of the r.f. business

As will be clear by consulting the diagrams, this relay and the antenna send-receive relay are actuated by the transmitter plate switch, 3.

Now all this sounds like a complicated mess. Actually, once it is decided what type of work is going to be done, the operation is even simpler than usual. For example, suppose we wish to get set for phone QSO's: Switches 1, 2, 4, and 9 are closed. Switch 6 is thrown to modulator and switch 7 to receiver. All subsequent activity is controlled by a single switch, 3, the plate switch. Closed, you are ready to speak; open, it shifts the antenna, closes the receiver B–, and you are ready to listen. This is one operation less than customary practice, which requires separate antennaes and a separate receiver stand-by switch. For c.w. operation, simply open switch 4, leaving the others as for phone. For operating the phonograph, only switch 1 need be closed, and switches 6 and 7 shifted to speaker and speech amplifier respectively. The motor is then separately controlled by switch 8, and the phono gain control turned up. For plain reception, only the receiver switch, 9, need be used. In short, despite the inordinate number of switches, operation is actually very simple, and the flexibility and diversity of uses are pleasurable. Strictly speaking, the phonograph is not part of the ham station; yet it is a nice thing to have and softens the wifely heart to the parlor rig. The receiver, by the way, is fitted with extra coils and does double duty as the family b.c.l. set.

The logical, centralized system of control and operation, while not so dear to the hearts of many of our haywire loving hams, is the only way to put together a station for the maximum of operating pleasure with a minimum of wasted space. Any outfit of comparable complexity would require a like number of controls, although one usually doesn't notice them because they are thrown all over the place.

A word about the cabling: If one checks up on the wiring, it will be seen that the rig has been so designed that no high voltage or current is transported except in two instances: The first is the cable between the "B" supply and the receiver, and is of no importance; the second consists of two leads carrying final stage plate voltage, one from the transmitter to the modulator, the other from the modulator to the main power supply. These are extra-insulated, and are made through feed-through insulators. The outfit is as safe as possible.

A number of local hams who have seen the rig have asked about ventilation. Quite a lot of heat is developed. However, the back is open to the air at strategic points, and a few inches clearance from the wall allows ample circulation. The interior of the secretary is thickly lined with asbestos. No trouble is expected.

Trouble Shooting in R.F. Stages

[Continued from Page 60]

ing leads which go from the grid of each tube to the plate of the other, not shown in the circuit diagram, should be approximately the same length as the direct path through the tubes.

Proper push-pull design, therefore, appears to call for very short leads from the tube elements to the tuning condenser rotors, through the condensers, and between the midpoint of the rotor and the filaments of the tubes. Most important is the path from the grids through the grid tank condenser to the filament; the plate circuit is generally longer through the tube, the larger tank condenser, and back to the filament. The shortest possible plate-to-ground circuit, because of tube and condenser size, is likely to be much longer than the short, high frequency, grid-to-ground circuit so that a tuned-plate tuned-grid u.h.f. oscillation, with the tubes effectively in parallel, is not likely to get started. Inductance of the neutralizing circuit can be held down by using wide leads.

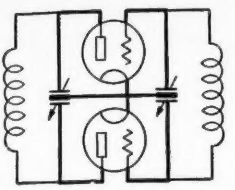


Figure 7. Simplified push-pull circuit showing semi-resonant parasitic circuit in heavy lines through which tubes can oscillate in parallel.

The amplifier in figure 6 proved to be very hard to drive on 14 Mc.—a half kilowatt on the driver being necessary to keep the plates from melting with a kilowatt on them. The grid current, even at best, was low; in fact, the grid-milliammeter was more often below zero than above. This indicates negative grid dynatron characteristics, more often found with water-cooled tubes, in conjunction with a single series or parallel tuned parasitic circuit. Occasionally the grid tank circuit will permit oscillation on the fundamental frequency even with perfect neutralization. The parasitic circuit can be damped, but the fundamental grid tank cannot. Getting new tubes without negative grid characteristics is perhaps the next most simple remedy.

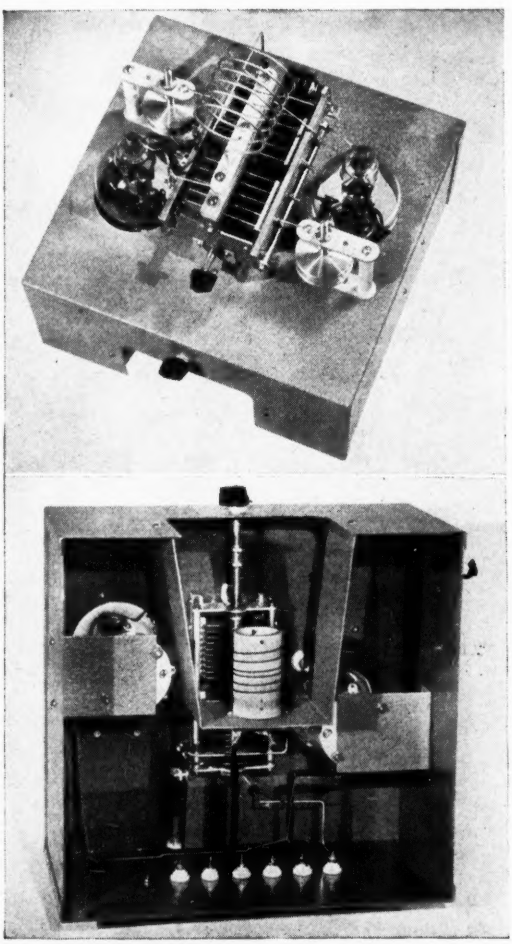


Figure 8. A push-pull amplifier illustrating the design principles given herein. The amplifier is built upon a 6" deep by 12" square chassis with all the grid circuit shielded from the plate circuits. The plug-in grid coil may be changed from the front through the cut-out in the chassis. The circuit diagram is conventional; a pair of 100TH tubes are used.

Parallel Tubes

A very high frequency inter-tube oscillation often occurs when tubes are operated in parallel. Non-inductive damping resistors in the grid circuit, or short inter-connecting grid leads together with small plate choke coils, very likely will prove helpful.

Tapped Inductances

With capacity coupling between stages, particularly when one of the stages is tapped down from the end of the coil for loading, additional parasitic circuits are formed because of

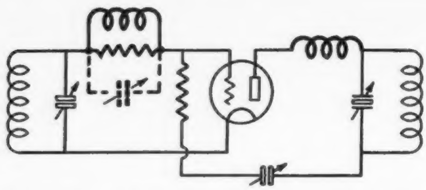


Figure 9. Damping and detuning elements in amplifier circuit (heavy lines).

the multiple resonant effects of this complex circuit. Inductive or link coupling permits making adjustments without forming these undesired circuits. Likewise, a condenser tapped across only part of an inductance, for band-spread tuning or capacity loading, makes the situation more complex.

Multi-Element Tubes

Screen-grid and pentode tubes may help to eliminate parasitic circuits by using no neutralization, but their high gain occasionally makes parasitic oscillation easy, particularly when some form of input-output coupling exists. Furthermore, the by-pass circuit from the additional elements to the filament must be short and effective, particularly at the higher frequencies, to prevent undesired internal coupling. At the high frequencies, a variable screen by-pass condenser at some settings may improve the internal shielding without causing a new parasitic oscillation. A blocking (relaxation) effect may occur if the screen is fed through a series resistor. The screen circuit can, of course, act as the plate in a tuned-grid tuned-plate oscillation that can be detuned or damped at the control grid terminal.

Crystal Stages

Crystal oscillators are seldomly suspected of parasitic oscillation troubles even when crystals are punctured. Ordinary as well as parasitic circuit coupling between the grid and plate circuits should be held to a minimum by separating or shielding the grid and plate leads, and by reducing the area of the loop from grid through the crystal holder to the filament. Keeping the grid circuit short, even adding a small choke coil of a few turns in the plate lead next to the tube, will probably eliminate the possibility of high-voltage series-tuned parasitics.

Suppressing Undesired Oscillations

We have already discussed some of the methods of damping parasitic oscillations using non-inductive resistors of a few up to fifty ohms, and detuning them with coils of six or eight turns of wire wound on a half-inch diameter placed in a lead near the tube. Sometimes a choke coil shunted by a resistor or a small trimming condenser will also be effective. Some of the uses of these in a single-ended circuit are shown in figure 9.

Link Coupling

Occasionally, reversing a link connection will alter the coupling between two stages. This indicates that coupling already exists and can be aided or bucked by the link circuit. As long as the coupling is between desired tank coils, all is well; if it is between the input of one stage and the output of the next, probably there will be undesired regeneration or degeneration.

Conclusion

Even a well-designed, simple layout may be troubled by one or another of the difficulties mentioned above. Every amplifier should be tested and any necessary measures for the prevention or cure of the undesirable factors should be taken. A good share of the fun in amateur radio lies in "chasing bugs"—if it doesn't get you down—not the operation of a faulty transmitter generating QRM and little slips from the F.C.C.

The Barrage Antenna

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wires which should be soldered at this time. Since these insulators are placed at a current point in the array, it is not particularly important that they have a long leakage path; any small insulators capable of carrying the strain may be used at this point.

The assembly had best be made in a large flat space directly under the place where the array is to be raised. In our particular case the antennas were installed atop a hill some distance from the transmitter. The various sections were carried to the top of the hill and laid out in their proper positions as indicated in figure 4. Each of the half-wave phasing sections is given a half turn (as indicated in the diagram), the various ends of the wires are

thoroughly scraped and then soldered in place with a *hot* soldering iron. We resorted to a plumber's gasoline stove and an old-fashioned soldering iron to do the job. A small alcohol torch should prove quite suitable also.

After the array has been assembled, the feeders or stub are attached and the whole thing raised. Incidentally, it is quite disconcerting to note how high the supporting poles must be to raise a 20-meter array so that the bottom sections will clear the ground a respectable distance. However, our experience has shown that the bottom of the array need not be a great distance above the ground. In one particular array, a 20-meter one, the bottom sections only cleared the ground by about six feet but no detriment to the operation was noticed from this small clearance.

If the array is to be fed as in figures 3B, D, or F, it will be only necessary to connect the transmission line to the array and fire it up. However, due to the small mismatch in impedance between the line and the array, standing waves will be noticed upon the line. But the mismatch is comparatively small and the standing waves will be of small magnitude and will not interfere with operation. The only disadvantage is that the particular point at which the feeders are coupled to the transmitter will determine the amount of coupling required. If they are coupled to the rig at a point in the vicinity of a voltage node, less coupling will be required than if they were coupled at a point near a current node.

If it is desired to operate the transmission line as a true untuned device on which no standing waves exist, a stub, as in figure 3A, C and E will be required. Of course, in the larger arrays where the impedance at the point of feed is close to that of the transmission line, the standing waves will be small without the use of an impedance-matching stub.

If the stub is used, it can be resonated in the conventional manner by parasitically exciting the array from a small antenna in the vicinity, and then sliding the shorting bar up and down until maximum indication is obtained on an r.f. milliammeter connected across or in series with the stub. When resonance has been obtained, the feeders can be attached to the stub and slid up and down until standing waves are eliminated. The correct point of attachment will be found to be usually in the vicinity of 1/16 to 3/16 wavelength up from the short whether the stub is ¼ or ½ wavelength long. The larger the array, the further up on the stub will be the proper position for attachment.

The results obtained from arrays of this type have been truly gratifying; much more satisfactory results have been obtained from this type than from other arrays comparable in size.

Dx

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pounding, as he had succumbed to phone. After reading on at great length about it I put his letter down and turned on my receiver for a little diversion. The first signal I tuned into was on 14,004 kc. and it signed W5DNV. I thought the whole thing was a gag but after actually hooking up with the guy, I plied him with questions. Sezze, "Well, I figured if that staunch c.w. lug, W8CRA, was on phone it was time for me to get back on c.w." W5DNV's putter-outer uses a 354C in the final.

W6NEP is a new one for the phone section . . . 21 and 53. So is Ken Moore, W6PDB, our eminent staff artist, with his 20 zones and 24 countries . . . all on 28 Mc. Ken is using one of those barrage type antennas. Anyway the thing works to beat h-h-h-heck. My, my the phone boys are going to town. Here's W4TS with 21 and 45. W4TS uses a couple of 803's, suppressor modulated. Charles Endres, who is W8RL (roaring lions), has done nobly and they add up to 27 and 58. A maximum of 275 watts input has been used for all contacts.

An interesting incident happened at W6NNR recently, which I think will bear printing. Guy was in a 4-way QSO with three other stations, W9YGC, W8ORI and K6OQE, when the telephone rang. He

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Buyer's Guide

Where to Buy It

PARTS REQUIRED FOR BUILDING EQUIPMENT SHOWN IN THIS ISSUE

The parts listed are the components of the models built by the author or by "Radio's" Laboratory staff. Other parts of equal merit and equivalent electrical characteristics usually may be substituted without materially affecting the performance of the unit.

ADAMS SUPERHETERODYNE

R.f. Assembly (general coverage)—Meissner 7511
R.f. Assembly (5 to 555 meters)—Meissner 7512
(If the receiver is to be used primarily for amateur communication work, it is recommended that the latter of these two assemblies be used. It does not cover the long-wave band but does afford coverage of the 56-60-Mc. band and employs an r.f. stage on the 28-30-Mc. band.)
Chassis—Standard 10"x17"x3" blank, or Meissner type 18281 punched
I.f. expansion and a.v.c. switches—Meissner 18254
T_1, T_2—Meissner 7412 transformers
T_3—Meissner 5714 transformer
T_4—Meissner 6762 diode transformer
T_5—Meissner 6753 b.f.o. transformer
T_6—Jefferson 467-177 output
Power transformer—Jefferson 463-411
CH_1—Jefferson 466-190
CH_2—Jefferson 466-290
Audio plate feed choke—Jefferson 466-380
Magic eye holder—Amphenol MEA-6
R_{10}—Yaxley L control
R_{18}—Yaxley H control
R_{27}—Yaxley A5MP control
$C_{14, 15, 16}$—Aerovox GLS-5 8 µfd.
C_{16} (audio by-pass)—Aerovox PR25 25 µfd.
Tubular condensers—Aerovox 484
Mica condensers—Aerovox 1468

GRIGGS "MITY MITE"

All mica and tubular condensers—Cornell-Dubilier
Can-type and paper filter condensers—Cornell-Dubilier
Wire-wound resistors—Ohmite
C_7—Bud 911
C_9—Bud 1559
$RFC_{1, 2, 3}$—Bud 920
2½" coil forms—Bud 736
1½" 6-prong amplifier coil forms—Bud 310
1½"—5-prong oscillator coil forms—Bud 126

TZ-40 BANDSWITCHING RIG

Mica capacitors—Aerovox type 1450
Midget mica capacitors—Aerovox type 1467
Wire wound resistors—Ohmite Brown Devil
Turret Coil Assembly—Barker & Williamson
Bud Radio, Inc., parts as follows:
C_1, C_2—Type 898
C_3—Type 897
C_4—Type 1518
C_5—Type 1553
RFC_{1-2-3}—Type 920
RFC_4—Type 876
Jacks—Type 233
Tube and Coil Sockets—Bud Isotex
Coil Forms—Type 126

The Marketplace —— Advertising Index

(a) Commercial rate: 10c per word, cash with order; minimum, $1.00. Capitals: 13c per word. For consecutive advertising, 15% discount for 3d, 4th, and 5th insertions; 25% thereafter. Break in continuity restores full rate. Copy may be changed often as desired.

(b) Non-commercial rate: 5c per word, cash with order; minimum, 50c. Available only to licensed amateurs not trading for profit; our judgment as to character of advertisement must be accepted as final.

(c) Closing date (for classified forms only): 25th of month; e.g., forms for March issue, published in February, close January 25th.

(d) No display permitted except capitals.

(e) Used, reclaimed, defective, surplus, and like material must be so described.

(f) Ads not relating to radio or radiomen are acceptable but will be grouped separately.

(g) No commissions nor further discounts allowed. No proofs, free copies, nor reprints sent.

(h) Send all Marketplace ads direct to Los Angeles accompanied by remittance in full payable to the order of Radio, Ltd.

METER Repair—D.C. Milliammeters, springs repaired $1.75. Change range, new scale $1.75. Thermocouples 1 to 5 amperes, $2.50. Change thermocouple range add 25c. All repairs reasonable. Braden Enginering Co., 305 Park Dr., Dayton, Ohio.

QSL's—SWL's: UNBEATABLE BARGAINS! FRITZ, 455 MASON, JOLIET, ILLINOIS.

EXTRA deep chassis. Panels. Special fittings. R. H. Lynch, 970 Camulos, Los Angeles, Calif.

CRYSTALS: Eidson's "T9" 40-80 meters, $1.60. C.O.D.'s ok. Van Radio, 464 East 117th, No. 7, Cleveland, Ohio.

DOUGLAS Modulation Transformers match all tubes. A quality product. Designed by W8UD. Sold by W9IXR. 50 watts audio $4.95 pair. 100 watts audio $7.75 pair. Guaranteed. Postpaid in U.S. For details write W9IXR, Rice Lake, Wisconsin.

QSL's, 2 colors, $1.80 for 300 post paid. W9DGH, 2005 North 3rd Ave., Minneapolis, Minn.

SELL or Trade: 250 watt fone, rack, panel transmitter. R.F. 802, 802's parallel, T55's Final; Audio 4-46's class B modulators. Rectifier 4-866 bridge, 1000 V-2000V-400 MA. WAS. Photos. Take $200. Want sound on film recorder, Presto, Universal recording outfit. Unit f.o.b. W9KHC, 1239 Kinsmoor Ave., Fort Wayne, Indiana.

LISTEN for High Frequency Broadcast Station W9XA, 26,450 Kilocycles, Kansas City.

NEON CALL LETTERS—Panel Mounting. 1-½" high, $2.50. With transformer, $5.00. Knorr Laboratories, 5344 Mission St., San Francisco, Calif.

ALL New: Franklin transformers 6000v; 5000v; 4000v; 3000v; 1200v: Chokes, 150T; 50T; HK154; 800; 804; RK25: Used ACR175; PR10, preselector. W6MVK, Modesto.

QSL's—HIGHEST QUALITY—LOWEST PRICES. RADIO HEADQUARTERS, FT. WAYNE, INDIANA.

FOR Sale: Comet Pro receiver, $50.00. Phone Twin Oaks 6870, Los Angeles.

FOR Sale: Dismantled 150-watt transmitter. 50T, "B" 801's, 4 power supplies, many extra parts, modern. W6NPG. FI 7336 during day.

SELL: 30-watt Class B modulator and speech amplifier. Complete 2A6, 56, transformer, p.p. 45's, transformer, p.p. 46's, output transformer and power supply. $25 takes all. Eilen RX-14-AB communications receiver. 5 bands and band spread. Like new. First $20.00. W9ZAA, Athens, Illinois.

CHRISTIANITY ACCORDING TO SCIENCE. (Not Christian Science.) 25 tracts 50c. Booklet 10c. Canadian Mailers, Walkerton 4, Ont., Canada.

Dx

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naturally answered it and it was John Boles on the other end. (Yes Josephine, John Boles, the "movie star".) John Boles is an ardent amateur fan and was intensely interested in this three-way QSO, as he was hearing all sides of it. Guy put the telephone up to his mike and told John to go ahead. Using the call "JB", Boles had a big time talking to these stations. He may be a *ham* yet . . . although an "amateur" might sound better to him. W6NNR now has 31 zones and 71 countries. Guy has recently made some changes in his rig, consisting namely of putting a pair of 250TH's in the final. His tank condenser flashed over occasionally so he yanked it out and installed one of the new Eimac vacuum condensers. It might be mentioned here, that a good way to tune the coil when using one of these condensers is to take a small variable condenser and connect it across the two center turns of the final tank coil, thus acting as a trimmer or padder. This condenser need only be of a much smaller type as there will not be much r.f. across two turns. Guy finds it quite satisfactory, and the whole amplifier now is much more compact.

More Cigars . . . . . W6LYM This Time

It must be in the air, and if so the Heaviside layer seems to be just right for the dx gang. All of a sudden W6LYM shows up passing out cigars, with a smile on his face like he had worked Zone 23. Anyway, the event took place on June 15th, and Norol says his rhombic antenna system didn't have a thing to do with it, but did admit the oranges from his grove may have helped. Norol's Jr. op seems to have the wrong idea about ham radio, as he causes too much QRM late at night. Congrats, Norol . . . and fellows, everyone is doing nicely, especially LYM.

W1JCX was informed by VP4TK that VP4GA is a bl in Trinidad, so all of you feelows who worked him better start gunning for VP4TK to make it stick. W1JCX is on 14-Mc. phone mostly and is doing swell work with ZB1L, HA1G, SP2HH, SM5OZ, I1RE, etc.

Latest additions and changes in the "WAZ" Honor Roll appear below. The complete list will be published in the next issue of RADIO.

	Zones	Countries
W6CXW	39	144
W6GRL	39	138
W6ADP	39	140
W2BHW	38	132
W5BB	38	118
W6GRX	38	111
W9KG	38	106
W6QD	37	123
W6LYM	37	111
W2GVZ	37	109
LU7AZ	37	93
W2BXA	37	105
K6AKP	37	67
VK2EO	36	112
W6ITH	36	86
W3GAU	36	107
G2QT	36	98
W6TI	35	71
W7AYO	35	91
W6AQJ	35	92
W3TR	34	96
G2IO	34	93
K6JPD	34	
W3GHD	34	90
W8OXO	34	90
LU3DH	33	81
W6CEM	33	88
W6KQK	33	63
VK2EG	33	69
K6CGK	33	61
W6KUT	32	85
G5VU	31	73
W8JSU	31	58
W6GNZ	31	85
PHONE		
W6NNR	31	71
VE1CR	30	68
W9BCV	28	58
W8RL	27	58
W6GCT	27	49
W7BVO	26	38
W5DNV	26	60
W6LYM	25	39
G6BW	24	53
W6NCW	22	23
F8VC	22	42
W6NEP	21	53
W4TS	21	45
F8KI	20	53
W6PDB	20	24

56 Mc.

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of the null. A vertical will have a maximum where the horizontal has a null, and the reciprocal. This suggests using two receivers on modulated signals with either vertical and horizontal antennas at the same height, or antennas separated at least two wavelengths. Operating them on loud speakers in the same room gives a diversity effect, reducing fading on this type of dx.

From a theoretical standpoint at least, an antenna effectively two wavelengths high and in the clear will give good low-angle efficiency for the ionosphere type of dx, though it would probably be inferior to a much higher antenna for 100-200 mile work. In either event, vertical stacking of the elements or use of end-fire arrays will increase the low angle efficiency. A properly designed rhombic can be used if it is pointed in a desirable direction. Long V antennas are good, particularly when they are 50 to 100 wavelengths long (the latter requiring about $9\frac{1}{2}$ degrees between the wires) in which case such an antenna is aperiodic just as is a properly terminated rhombic, and it becomes unidirectional.